THE TELEGRAPHIC JOURNAL AND

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DYNAMO TESTS.

A FORTNIGHT ago we pointed out several discrepancies between the indicated and electrical horse-powers as obtained from a Willans high speed engine driving direct a Crompton dynamo, and in reply to our remarks we publish in our Correspondence columns to-day a letter from Messrs. R. E. Crompton & Co., which is intended to be explanatory of the results we criticised. The discrepancies are said to be due to the difficulties of keeping up the steam pressure in boilers too small for their work and in taking indicator diagrams simultaneously with electrical observations, it being further stated that the main question as regards fuel consumption per E.H.P. remains unaffected by the existence of such discrepancies.

In our previous article we accepted the efficiencies as published in the report and requested to know the cause of the variations, but our correspondents ask us to change our ground somewhat. Now we are told that due to the want of simultaneity between the taking of the diagrams and the electrical observations the efficiencies given may be incorrect, and that while great care was taken to get simultaneous readings, in some cases the indicator cards were taken a few seconds later than the electrical readings. We fully appreciate the difficulties of the test, but we do not see how the above circumstances could account for such great variations if ordinary care had been adopted in the signalling. Moreover, the errors due to this cause might have been practically eliminated if the test had been conducted with due regard to the steaming capacity of the boilers.

One of the main objects of the test was to ascertain what percentage of I.H.P. in the engine cylinders could be obtained as useful E.H.P. at the terminals of the dynamo, and we consider, therefore, that one of the main questions is at issue here. Admitting that the boilers were too small for the maximum load put on them, it would have been easy to work for two hours with constancy had the load been somewhat smaller, and it does not agree with our ideas of testing to work under circumstances which entail excessive periodic fluctuations when under a proper adjustment of the electrical output to the steaming capacity of the boilers such prejudicial effects could be avoided. With foresight, the first two hours' run would have enabled the experimenters to determine what electrical output could be maintained with constancy; and it would have been far more satisfactory if, instead of working by fits and starts, the experiments had been conducted after this method. With the lowest I.H.P., namely, 101·57, the efficiency is said to be 75·7 per cent.; so that with less load there would have been, if this figure is correct, a clear gain in efficiency. There is no load so easy to manage as an electrical one, which can be adjusted with the utmost nicety; and when we have to deal with boilers which err on the side of insufficiency, the errors due to this cause should be eliminated as far as possible by reducing the load to a point which can be maintained with constancy throughout the trial. When this is done, errors due to the lapse of a few seconds between the taking of the diagrams and the noting of the electrical observations are practically unimportant; and discrepancies such as those indicated would be impossible unless the efficiency actually varied, as we have before suggested, due to variations in the internal engine friction. As the figures stand, we are in a somewhat worse plight than when penning our former remarks, as we are now uncertain whether the efficiencies given are true or false. We think, however, that with a view to avoiding errors in future tests, our remarks on the subject will be found worthy of consideration.

If we reject, as suggested, all the efficiency tests and consider merely the water consumption per E.H.P., the result is a good one; but we have heard since publishing our previous notice that an efficiency of over 70 per cent. has been obtained by other makers from belt driving, the power being transmitted through counter shafting. Without saying anything about the interests of students being served by the publication of Messrs. Crompton's tests, we can at least aver that they have in these results abundant food for thought.

In conclusion, we may call attention to an error in the diagram which shows the I.H.P. and E.H.P. developed during the run. Owing to some mistake on the part of those who furnished us with the drawing, the readings of I.H.P. from 7 : 5 onwards are plotted twenty horse-power too high.

ELECTRIC LOCOMOTION.

By A. RECKENZAUN.

XVII.

TELPHERAGE is another branch of electric locomotion which is destined to play an important part in industrial undertakings where minerals and goods of every description have to be conveyed to distant places, over fields or mountains and across rivers, where railways, roads and bridges are scarce. This system is intended to supply a want in countries where the resources of a fruitful soil lie dormant, because the cost of conveyance of crops or minerals to the distant railway or harbour, is rendered too great on account of the absence of convenient roads and bridges, and the amount of traffic is not sufficient to warrant the expenditure of a large capital. Telpher lines are not to supplant railways, but to serve as feeders of such. It is claimed that this system offers advantages over the teledynamic transmission (rope gearing) where considerable distances have to be traversed, and especially where many curves or corners occur on the route.

The first telpher line was erected and shown at Weston on the estate of Mr. Prior and a larger and more complete line has been in operation at Glynde, in Sussex, since October, 1885. This system has been so recently and so fully described by Prof. John Perry in

his admirable lectures at the London Institution, that it would be difficult to add anything or suggest uses to which it may be adapted other than those already thought out by Prof. Perry and his energetic colleagues. Those who have attended the lectures referred to, or who have read the same and studied the illustrations, must have been struck with the number and variety of ingenious details; an immense amount of thought has been bestowed upon telpherage, and there is no doubt that the instances where this system can be advantageously applied are numerous. The doubts and fears which have been entertained by many as regards the economy of electricity when applied as a medium of transmission of power are gradually disappearing. Almost daily new facts are brought forward which supply the desired proofs, and sceptics are rapidly being converted into firm believers. The commercial efficiencies of dynamos and motors, it has been shown, are such as to render electrical transmission one of the most economical and most reliable, and the time is drawing nearer when this form of energy has to be taken into serious consideration, when questions as to the best or the most convenient mode of transmission of power have to be solved; this aid to engineering solution has come upon us with rapid strides and we are almost anxious, lest engineers in general may not be prepared to fully appreciate the progress made in this branch of engineering. The efficiency of any system can be calculated with absolute certainty and the cost of installations is easily ascertained. Advocates of particular systems occupy themselves seriously with the task of perfecting small details, whilst the general principles are supposed to be well understood; this is a healthy sign, for it is upon the care and attention given to mechanical details, the material and workmanship, that the continued success of any system will depend. The question of the cost of the source of energy may be considered as settled, and it depends solely upon points of convenience, maintenance, and the depreciation as to whether one system will gain ascendancy over another.

Passing on from electric tramways and telpherage we will next devote a few words to another branch of electrical engineering, perhaps not as important but equally interesting, that is electrical navigation—an imposing title, which reminds one of steam navigation, and of enormous ocean ships and even torpedo boats steaming at 24 knots an hour. The claims of electricity as a motive power for the propulsion of boats are, however, still very modest. Nothing "big" has as yet been attempted, and is not likely to be attempted for some time to come, unless discoveries of an extraordinary nature are made.

There is no hope, as yet, that ocean ships will be electrically propelled from port to port; large marine engines are exceedingly economical in fuel, and the present methods of storing electric energy cannot supersede the carriage of fuel as regards weight or space; and we must be contented with the application of electricity to the propulsion of launches, be satisfied with moderate speeds and voyages lasting hours, but not days or weeks, without replenishing the expended energy. Assuming that one horse-power (effective) can be obtained for one hour with 150 lbs. weight of secondary batteries and motor, then we should require, for a supply of 24 hours' continuous run, 1·6 tons of propelling apparatus; this weight can only be carried by a boat of certain minimum dimensions, because 1·6 tons represents a displacement of nearly 58 cubic feet of water; adding to this the displacement caused by the weight of the hull itself, we get some 70 cubic feet, and this will involve a boat of about 25 ft. length, 5 ft. beam, and 18 inches mean draught of water. It is doubtful whether one horse-power (effective) will give a speed of four miles an hour to such a vessel. But the said weight of apparatus, when rationally arranged, will give a speed of about seven miles an hour in still water to a 25 ft. launch, if we use the energy at the rate of four horse-power, and run for six hours only; but at the slow speed we may be able to travel 96 miles, whereas at the rate of seven miles an hour the stored energy will carry us a distance of 42 miles only with one charge. This result will be regarded as quite sufficient for the purposes of pleasure launches or tenders attached to large steam vessels. If charging stations were provided at suitable distances apart on our navigable rivers, then it would be an easy matter to replenish the energy at intervals, and pleasure trips of any length could then be made on electric boats.

As an auxiliary power to small sailing yachts, electricity should find extensive application. The apparatus can easily be stowed under the floor, and the whole of the boat would be left clear without in any way detracting from the beauty of the sailing boat; such apparatus would serve as the ballast, which ballast can be made use of during a calm, or at any moment when the convenience of a motive power, other than wind or tide, may be desirable. When not in use, the energy stored in accumulators remains unimpaired for many weeks, and is always in readiness; this latter advantage will be found of great use.

Absence of smoke, of heat, of noise, and the ease with which electric launches can be handled by anyone, render these peculiarly adapted for pleasure purposes. Attached to men-of-war ships, in harbour duties, electric launches will be found of great convenience. Police boats should all be propelled by electricity; and this subtle force is now successfully applied to submarine boats and to the propulsion of navigable balloons.

The author has treated this subject of electric launches on so many occasions, notably, in communications to the ELECTRICAL REVIEW in December, 1882; the British Association, 1883; the Society of Arts, 1884; that any further remarks are unnecessary, unless they refer to recent improvements in details of construction, and practical examples will be described at an early date.

AN IMPROVED METHOD OF CABLE WORKING.

By J. EBEL.

WHEN the length of time that has elapsed since the discovery that telegraphy was possible over long ocean cables is taken into consideration, one is forced to the conclusion that very little advance has been made in the systems of practically working such cables.

It is very probable, however, that many electricians have arrived at some method of improved working which, for some reason or other, they have not made known, and, in reflecting on the small progress that has been made in this particular branch of electrical science, regard should be had to the fact that it is very difficult for students and inventors to obtain access to the cables themselves to test theories by experiments. It is very likely, in a great measure, due to the want of such facilities that some improved systems of working have not long ago been devised.

On searching through some back numbers of this journal, I find, in the issue of Dec. 26th, 1885 (page 357), an article on duplex cable working, which induces me to submit a system which, I venture to think, may be found a further advance in the same direction, feeling fully satisfied, after careful experiments, of its practical application.

No doubt, much credit is due to Mr. Muirhead for having brought into use a simplified system, but there does not appear to be anything particularly new in the diagrams illustrating the article in question, and some years back, in the course of some experiments on working duplex, I made use of two condensers connected in the same manner as shown in the diagram referred to, where I proved the bridge wire to be superfluous. I was not aware at that time that this idea was already known. (See Provisional Patent Specification, 1879, No. 5119.)

The accompanying diagrams illustrate the result of my own investigations.

For working the duplex system where the bridge wire (sometimes called the fork) can be dispensed with, I maintain that the employment of a receiving instrument, with differentially wound coils, is preferable to the ordinary instrument.

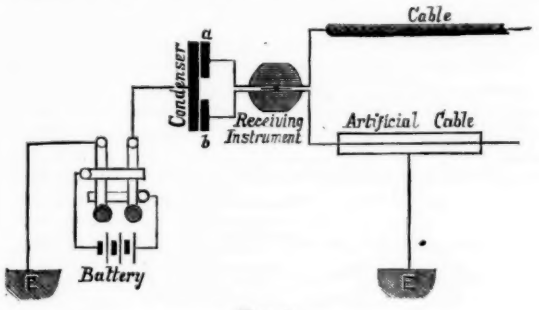


FIG. 1.

In fig. 1, a condenser is connected up, having three plates, or an equivalent thereto, two condensers with one plate of each joined. In this case, the middle plate is charged by the sending current, and the opposed *a*, *b*, discharge themselves each through half of the coil of the receiving instruments, which are so wound that when no current is received from the distant end of the circuit their effects neutralise each other.

In the event of any inequality in the rate of absorption of the condenser plates, *a*, *b*, means are provided for inserting resistance in one or the other half of the instrument coils, or by rendering the influence of the coil on the needle or magnet by moving the coils to or from the needle.

For working greater length of cables where the rate of speed depends on a well-established balance, the plan indicated in diagram, fig. 2, is employed.

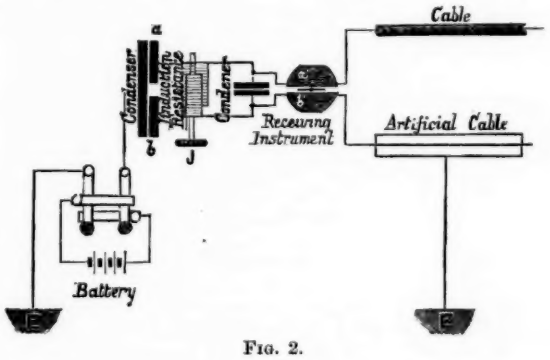


FIG. 2.

In this arrangement one additional subdivided condenser is inserted between the coils of the receiving instrument, a^1, b^1.

The capacity of the first condenser in regard to its plates, *a*, *b*, is as nearly as possible balanced. In the event of any difference in the absorption of the plates, a special form of adjustable induction resistance is employed, which is so constructed that, by means of a screw, I, turning to one or the other side, the difference

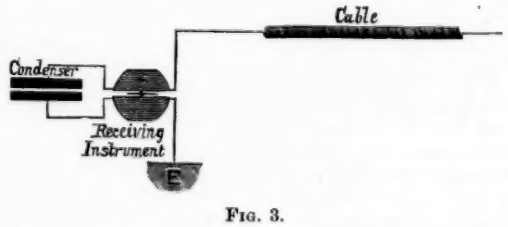


FIG. 3.

in the unequal absorption of the upper and lower condenser plates can be adjusted to a nicety.

Diagram in fig. 3 represents an improved system of working cables by simplex.

The receiving instrument is also supplied with a differentially wound coil or two separate coils.

The condenser is not, as hitherto, placed before or after the receiving instrument, but inserted between its coils, so that one plate is discharged through one part of the coil to earth and the other through the opposite part to cable, thus both discharges passing through the instrument will deflect the needle or coil in the same direction. By this means I purpose to utilise the induction between the coils in assisting the discharge, and so to neutralise the extra current developed in the said coil.

A higher rate of speed is obtained by this system.

ON AN UNEXPLORED FIELD IN ELECTRIC LIGHT OPERATIONS.

[A COMMUNICATION.]

IF conditions do exist under which incandescent lighting is capable of holding its own against any other form of illuminant, they are certainly realised when the installation is neither unmanageably large and complicated, nor too small to profitably employ skilled attendance and supervision.

The electric lighting of towns, hampered by panic legislation and by want of that practical experience in the arrangement of very large installations (which can only be attained by watching their gradual development and growth under every variety of conditions), has up to the present time shown a decided tendency to remain in the "provisional order" stage. And—unless legislators decide to allow a fair and gradual development to take place, and cease to expect that a matured and perfect system of town supply shall be brought forth like Minerva from the brain of Jupiter—we seem likely to remain permanently at that stage.

Since the time when the electric lighting industries were extinguished, domestic lighting has been chiefly represented by the introduction, in a more or less spasmodic manner, of small sets of apparatus for use in private houses, workshops, and business establishments. There are many objections and drawbacks to the isolated installation system—as, for example, the unqualified horror which many persons have of machinery in motion in their own home. Perhaps the most fatal objection is the heavy capital outlay. This bears especially heavily on the small installation, because a small-sized machine costs much more in proportion than a large-sized one. To cite actual figures: a dynamo with a maximum output of 1,500 volt-ampères costs £30, whereas for five times the cost a machine of 13½ times the output can be had. A well-known gas engine is quoted at £90 for a 2¾ indicated H.P. engine; for £350 an engine giving 15 times the indicated H.P. is supplied. Again, for a compound under type semi-fixed engine and loco. boiler a well-known firm quotes as follows:—10 H.P. nominal £300; 50 H.P. nominal, £1,000. In a cheaper class of engine the difference is still more marked. Thus we see that moderately large installations cost much less in proportion than very small installations, as far as prime cost of machinery is concerned.

In considering a town supply system, we meet with a very formidable item in the prime cost of main lines. When these are long and carry "heavy" currents they form a most serious item in the capital outlay, and therefore in the electric lighting rate. Hence the efforts that have been made to introduce systems which combine a very high "pressure" in the main line with a very moderate difference of potential at the house meter terminals. Among such systems the "B. T. K." and the "secondary generators" are prominent, and there is little doubt that a system in which centralisation and decentralisation are combined will eventually commend itself for all operations in districts which

consist of several small centres scattered over a considerable area.

But in those cases in which a few hundred lamps are spread over a comparatively restricted area, as, for instance, in a block of 20 or 30 houses, the interest on the main lines will be of less importance as compared with the cost of skilled attendance and supervision. If, therefore, we can so arrange that the district to be lighted is broken up into what may be termed "local groups," so as to avoid on the one hand the use of unprofitably small plant, and on the other the expenses attending the laying down and maintenance of an elaborate system of street supply mains, and if we can so spread the cost of skilled supervision over several of these gronps, that its power as a factor in the balance sheet is reduced to a minimum, we shall probably arrive at a very satisfactory medium, if not the proverbial happy one.

In the blocks of houses into which, for the most part, our suburban building estates are cut up, we have a notable example of the proper field for this class of installation, as we find several of its most favourable conditions present—a compact area of supply, an approach to the houses not involving expensive excavation in leading in, a ready means of laying the main lines and of repairing them, and with great facilities for adding branch leads or in any way manipulating consumers' wires. Taking a block of say 30 houses—15 on each side—we may look upon the boundary wall running at the bottom of the gardens, and the party walls running transversely, as so many roads or viaducts specially suitable for carrying cables. (Fig. 1.) If,

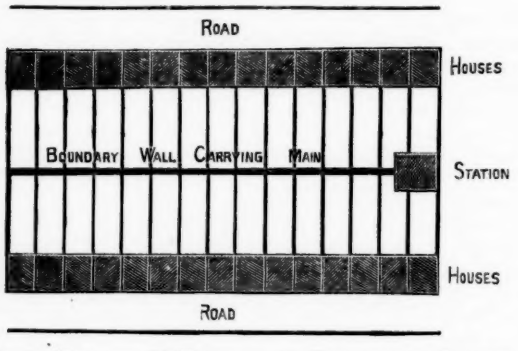


FIG. 1.—BLOCK OF 30 HOUSES TO BE ELECTRICALLY LIGHTED.

then, we can erect a dynamo driven by a gas engine at any convenient spot within the confines of the block we shall be able to supply light (and, if required, power) to any house in that block by simply attaching a branch lead to the main which runs along the boundary wall and leading it from the party wall into the house to be supplied.

The *station* in the figure is shown at the bottom of two of the gardens, forming, indeed, the continuation of the boundary wall. It would contain the dynamo, testing instruments, &c., with a gas engine or similar motive power to drive it. This shed could be built of corrugated iron, ornamentally treated, or covered with trellis work, so as to look as much like a summer house as possible. If the installation were sufficiently large to employ a steam engine and boiler, it would have to be of the most compact and efficient type, noiseless and automatic. In this case arrangements would have to be made to carry the flue-pipe either into the neighbouring copper chimney or into a specially erected iron chimney attached to the wall of the nearest house. It is doubtful whether steam power would commend itself, where a gas engine could possibly be used, on account of the much greater fuss and space which even the best steam engines necessitate, in attendance, storage of coal, water supply, cartage of ashes, &c., besides the element of unpleasantness which arises when a steam engine comes into the vicinity of fidgetty people. But whatever the machinery employed, it would have to be arranged with regard to the utmost economy of space.

The leads would be of the ordinary type, either built into the walls in troughs or simply laid down in wooden channels covered with Λ-shaped pieces of galvanised iron or with Willesden paper—the whole being fastened to the top of the wall. The main line would be tapped at every other wall, and the branch led into the house on either side, for although no saving would be effected in the cost of the conductor, yet only one trough would thus be used where two would be wanted if each party wall carried the line belonging to its own house.

House fixtures would be in no respect different from those used for ordinary installations.

Management and General Working Arrangements.

In new districts specially laid out to afford facilities for this class of lighting the working arrangements would be simple enough. The district would best admit of being profitably worked when several such installations were established within a short distance of each other. In this case one workman could superintend several sets at once, if worked by gas engines or other automatic motive power. This plan should suggest itself to builders laying out new estates, as it would be an undoubted attraction, especially for the better class of houses, to advertise them as fitted and supplied with electric light, with an optional supply of small power motors for driving sewing machines, lathes, &c., &c.

As to the financial side of the question. The works could either be erected by the builders (or at their cost), and the capital outlay apportioned to each house in the block, or the machinery and fittings could be the property of an electrical contracting firm bound by contract to supply electricity at a fixed rate, or on a sliding scale. Again, it might be worked on the co-operative system, and this would be the cheapest way. These, however, are questions which are entirely dependent upon the local circumstances of the case.

I have not thought it necessary to enter into any electrical details of these installations, for the very obvious reason that they differ in no respect from the arrangements for ordinary installations of the same size, and because it has been my purpose to offer food for reflection rather than detail, nor have I considered the question of working by accumulators. Every electrical engineer will have his own ideas on these subjects and will arrange the details in accordance with such ideas.

It is hardly necessary to state that this scheme is not proffered as a solution of the house-to-house supply problem; it must rather be considered as a means of familiarising the public with the light and of rendering the demand for a perfect system more and more imperative, and if it be realisable in practice, it may be looked on as the thin end of the wedge.

A. HAMILTON-CHURCH.

NOTE.—Since writing the above a new petroleum engine has been presented to the market, and if all that is claimed for it be realisable in practice, it should be a decided acquisition for electric lighting. But I have, as yet, seen nothing of importance respecting it.

Uxbridge, *April 12th.*

THE NIGHT PASSAGE OF THE SUEZ CANAL.

NOW that steamers are allowed to proceed through part of the Suez Canal at night with the help of the electric light, the problem for consideration and experimental investigation is how to make use of the light to the best advantage. So far the idea seems to have been to light up the way ahead by means of what is practically an electric bull's eye lamp. This search light is placed at the bow of the vessel, and a gradually widening beam of intense light is directed ahead,

showing up everything some hundred yards in advance to perfection. The part in the immediate neighbourhood of the ship is, however, left in darkness, made, by contrast, even more intense, so that a buoy near the bow cannot be seen at all, though those a few ships' lengths ahead are plainly visible.

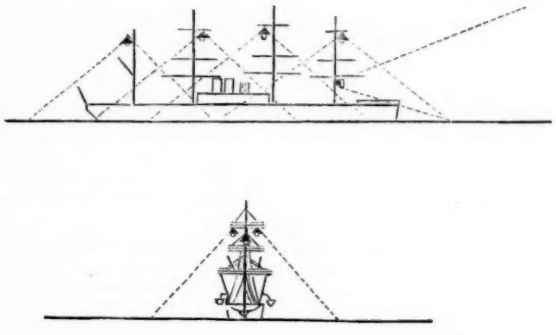
In the case of the P. and O. ss. *Carthage*, the search light was supplemented by two side lights and two stern lights, which were presumably screened from the deck in the same way as the search light, but these, I understand, were of little use.

The search light, I hear, was projected through a lens, which made the beam very narrow, not reaching the whole width of the canal until it was two buoys' distance ahead of the ship.

It is evident that a wider angle lens, or a reflector, would answer better, and probably the ordinary naval search light, which has a small reflector in front of the arc and a large one behind it, would suit all requirements.

I think, however, that the system of lighting is a bad one, and that a much better effect may be produced by using the available light in the following manner :—

To take the case of the *Carthage* to illustrate my proposed plan, I will premise that she is a four-masted steamer of large size, having the bridge, if I remember rightly, between the second mast and the funnels. The lamps supplied for her use in the canal were one search light and four presumably less powerful arc lights.



I propose that the four minor arc lamps should be hoisted, one at each of the four masts, at or about the level of the topmast heads, these lamps to be fitted with conical reflectors similar to the ones in use at the Royal Albert Docks, London.

These lamps would light up the whole ship as well as the canal banks adjacent, and the canal itself some little distance ahead and astern. The search light should then be placed about half way up the foremast, or slightly above the level of the pilot on the upper bridge, and the beam directed as far ahead as might be found necessary. In this way there would be good light everywhere, and some extra light ahead, and no light would be in such a position as to dazzle the eyes of the pilot or crew.

My experience of the canal navigation and its requirements, gained while officer in the "Star" and "Orient" lines, leads me to feel confident that the above plan would be found satisfactory.

Those who frequent the Royal Albert Docks will, I am sure, agree with me that there is no difficulty in proceeding through those docks at night, the electric lights overhead making everything distinctly visible.

In 1883 I had occasion to draw up a plan for lighting the canal from end to end by means of powerful arc lights on the banks, but I was always of opinion that, putting aside all question of relative cost, it would be better for each ship to light up her own way ; and I should be in favour of the necessary plant being supplied and worked entirely by the canal officials, so as to secure uniformity of results.

If the canal banks were lined with arc lights, the ones ahead would always shine in the pilots eyes, whereas, if the lighting is done on the ship, no such trouble is possible.

To return to the main point by an illustration : a servant girl looking for a burglar in the coal cellar, holds a light in *front* of her, screens her eyes with her hand, and sees nothing ; but a miner, who has gained knowledge by experience, sticks a candle in his hat *above* his eyes, and sees quite well.

VINCENT STEPHEN.

Author of "Wrinkles in Electric Lighting."

THE HUMAN BODY AS A CONDUCTOR AND AS AN ELECTROLYTE.*

IN the first lecture I made some observations as to the resistance of the human body. I showed that the first difficulty was due to insufficient contact. I ought to have mentioned that I have verified this fact. After taking observations with the wetted poles I spoke of, I thrust two long silver needles into the foot of the dead body, and took another determination ; it came out that although the needles were thrust into the muscular tissue the resistance was on the whole higher than what I had previously obtained. I then showed that another difficulty was due to the fact that the human body rapidly electrolises, and that a current of polarisation is set up within of very considerable power. That topic I wish to go into more closely to-day. I gave the direction in which it is necessary to take a current from hand to hand, from foot to foot, and from hand to foot, and I showed that the size of the patient did not seem to make any great difference, because tall men give, if anything, a lower rather than a higher resistance as compared with short men, the physiological law clearly coming out that as the length of the lever in the body so is the area of the muscles that move it. I gave some examples, and I mentioned an interesting determination which I had been able to make, with the assistance of Mr. Lant Carpenter ; and that I shall again have to refer to in the third lecture.

To-day, I do not wish to speak of the electrolytic action which takes place when a current passes through the body. Now, all fluids are electrolytes, and it is somewhat difficult to measure their resistance in some cases. So, also, are bodies imbibed with fluids, and there have been one or two researches, one by Du Bois-Reymond and another by Comte du Moncel, which I shall refer to again. In the next place, I shall show you how the current has to be taken back again, as in the case of an ordinary fluid cell which has been charged in the usual way. I will charge and discharge two fluid cells connected by a fine tube, which may be looked upon as a sort of electrical schema of the human body. In this case, the resistance is about 1,340 ohms ; the cells which I use are the same, and the E.M.F. in volts is the same as that which I made use of on the former occasion. This is a tube of salt and water, about two millimetres in diameter ; yet it takes nearly ten minutes to charge it all, and even then the vessel is difficult to use. It is easy enough to see by a sensitive galvanometer, and I hope it will be easy to demonstrate it. I must wait some little while until it is properly charged, and, in the meantime, I will make some further remarks.

This polarisation, of course, appears as an increased resistance, and besides Du Moncel's observations, there is an excellent paper by Drs. Waller and de Watteville, in the *Philosophical Transactions* for 1882, which I shall have to quote presently, I found when I came to make these charging and discharging observations that two things happened ; there is an initial throw, then a

* Second Lumleian Lecture, delivered by Dr. W. H. Stone, at the Royal College of Physicians, April 13th, 1886.

permanent deflection ; the galvanometer gives a great start, and then it permanently remains deflected. At first I attributed this initial start to something in the nature of a condenser action, and so I stated it at the meeting of the British Association at Aberdeen. I have been led by Prof. Hughes's beautiful researches somewhat to modify my views on that subject since then, and I think I have mentioned that it might be better designated under the name of self-induction, which I wish to speak of slightly to-day. At the third lecture I shall show that self-induction takes place during the variable period of the current, and that this constant current does not very visibly influence it. This galvanometer which I have here is not intended in any way to show it ; but should, as far as possible, cancel it, and only show the permanent deflection. Now this counter E.M.F. is considerably greater than I had anticipated. Presently I shall give you a very excellent measurement made independently of myself, and which is represented in the two curves. The upper curve shows very beautifully what really happens. The first part of the curve below the line of the middle is the period of charge, and all the measurements are given ; then the discharge takes place where the vertical line is. The galvanometer shoots up to the point *c*, at the top of the diagram, and goes down again, but not to the line of zero. On the contrary, it remains steadily, and for a very considerable time, very much longer than I had anticipated, discharged steadily through the galvanometer, without losing its charge. In that case, there are ten minutes noted, and the fall in current I shall speak of presently.

In another case, I have been able to produce a very much larger effect than that. That was intentionally taken with a small current, so as to be able to measure it with a delicate galvanometer ; but where you use larger E.M.F's., the quantity discharged is quite considerable. I, therefore, will mention some of those cases. They were three patients in St. Thomas's Hospital, and the electricity administered, I need hardly say, was not purely for electrical, but for electro-therapeutic purposes. The first was a case of sciatica, and the patient was very much atrophied in the leg, and was very much wasted altogether, consequently the resistance was somewhat high ; it was about 1,900 ohms. I charged him for twenty minutes with ten bichromate cells from foot to foot, putting the copper pole toward the leg suffering from sciatica—and I may say, incidentally, that I cured this sciatica. When I discharged him through a galvanometer, intended to reduce somewhat and modify the indications, the first throw was no less than 250 scale divisions, a very large throw indeed. I then discharged the lead poles to see if they were doing this work, and they only gave 20 scale divisions, so it was actually the patient, and not the electrodes, which had discharged. I passed the same charge through a condenser of $\frac{1}{3}$ of a microfarad capacity, and I got a scale deflection of 30, somewhat more than the poles gave, but infinitely less than what came from the patient.

In the second case I gave a constant current of 14 volts for half-an-hour, from the forehead to both feet immersed in a vessel of water. This was a case of diabetes ; and you are perhaps aware that it has been shown that there is a decided decrease of sugar under the influence of a constant current. The resistance here was only 600 ohms, obviously because the conductor was duplicated. I corrected this by Sir Henry Mance's method, and the resistance came down to 543 ohms, although I found there was a polarisation current of no less than 137 ohms, representing all that amount of difference.

The third case which I have to quote was another case of diabetes, in which the resistance was taken in just the same way, but with only six volts, from forehead to both feet. The man could not tolerate a stronger current ; he was extremely ill, and eventually he died. I there got 1,100 ohms, and corrected by Mance's method it came down to 1,025 ohms, of which the polarisation current represented no less than 145 ohms. Now this is a very large counter E.M.F., I think a very much larger proportion than would have been expected or than was before demonstrated.

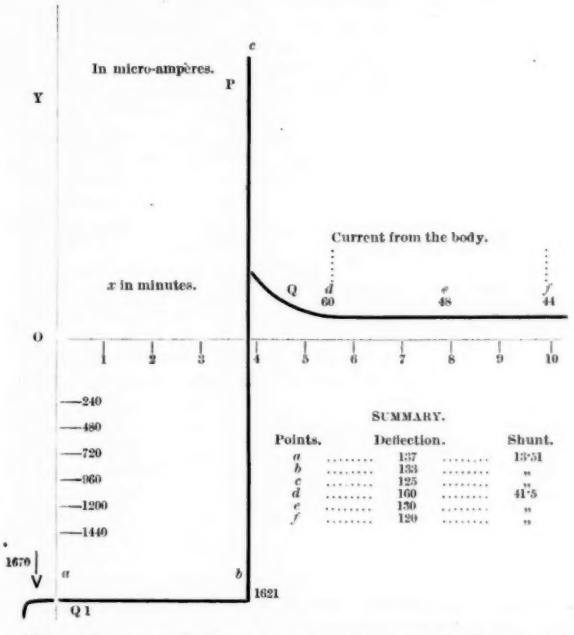
I will proceed with this experiment with the little schema or electrical man a little before the time, after nine minutes of charging. I will discharge it through the galvanometer ; I am afraid it will not show a very great deflection : the quantity is very small, but I think it is visible. It will go on for some time before the needle comes perfectly back to zero. I wish to charge the human body and keep it charged some little time. I will substitute the real man for the schema. Again, I shall not be able to do the experiment immediately. The resistance of the real man is somewhat less, but not materially less, than that of the schema.

Whilst that is going on I will take the measuring experiment which I mentioned before, and which I owe to the kindness of Mr. Lant Carpenter and his assistant, Mr. Wilkinson. Some of the resistance determinations I gave at the last lecture, if you recollect. One cell of 2 volts, as near as possible, was put on for four minutes ; the actual resistance for the first minute was 1,194 ohms ; it rose by polarisation to 1,230 ohms at the fourth ; the current passing was ·0016 ampères. Then two cells were put on, and the resistance remained steady, standing at 1,155 ohms. Then comes the test for capacity ; and on this test I eventually came to the conclusion that capacity was not the name for this action, although there is something of the nature of a piling up of the current, which is now better called self-induction. In the first experiment two cells were kept on for four minutes, and all the details are given in the diagram. The discharge at the end of the time was 185 divisions. Then the leakage was measured. The leakage on the testing table was found to be absolutely zero. The leakage between my two baths I could not quite prevent ; although they were put on an insulating material there was a leakage equal to 142 divisions, without a shunt. This was only ·03 per cent. of the test, and could be neglected. I then tried whether the bath on the floor took any charge themselves ; they took 268 divisions, but this was only ·85 per cent. Both these tests came out very much in favour of the accuracy of the observations. Then we got the constant of the two cells. The whole came out at what I have on the diagram, 1,155 ohms with a current of ·00346 ampères.

Then the second experiment, with one cell kept on four minutes, gave a permanent deflection equal to 187 divisions ; here, again, we have the 1,230 ohms. Then we discharged the patient himself, with no battery in circuit, through the galvanometer, and under the same conditions exactly, and we got a current from him equal to 60 micro-ampères. Three minutes after it had fallen to 48·7 ; two minutes after that to 45. Now, that I have thought so important that I have enlarged the curve and given it here on the diagram board. It is very nearly a straight line, and you will see that it discharges itself very much after the fashion of a secondary battery. I was not even satisfied with that, and I gave my two kind assistants a little more trouble. I asked for a curve to be plotted out, in which the original throw, the condenser action, should be blended with a careful appreciation of the charging current and the discharging current. There we have it (see page 395), and I have no hesitation in saying, it is a very beautiful experiment indeed. It opens a grand field for electrical research as applied to the animal body, and more especially the human body. Here is the charging current at *b* ; the discharge takes place, and up goes the galvanometer to *c*, and then it comes down and is carried on for ten minutes ; the fall of current is so very regular and so very slow that it almost forms a parallel line to the axis of *x*. This is only from 2 volts of current.

We then went on to see how much of this throw would occur with the needle swinging under its own inertia. Another test was therefore taken under the same conditions, using an inert instead of a polarisable resistance—using an ordinary resistance instead of a man. The needle did not reach its previous point, did not fly out so far, therefore the difference between

those two must have been the measure of the polarisation which took place. Here [indicating on the diagram] it was from *c* to P. That is a very small quantity, but the E.M.F. was very small indeed, only just competent to combat the counter E.M.F. Water can hardly be decomposed by one cell, and we only had one bichromate cell. Yet we got that very decided difference which I think completely proves what I have been contending. The result of all this is that as regards the electrostatic capacity of the body, it is very difficult to separate polarisation from capacity ; and perhaps it is wiser not to say that it is capacity, but that there is self-induction stands before you, I think, in very definite figures.



Now the ten minutes are up, and I will discharge my human condenser. [Does so.] The deflection is quite visible. Now this has a very important physiological bearing, a bearing on Electrotonus. I confess I always have in former times been sceptical as to the reality of electrotonus. Nearly every writer seems to inveigh against its inconsistency, the difficulty of getting results, and the difficulty of getting the meaning of the results when they are found. Here, for instance, is the last work of Rosenthal, who says :—"It sometimes goes one way, and sometimes the other, and there have been great disputes as to it." Then there is an excellent but rather bulky volume by Drs. Waller and de Watteville, which mentions various authorities, and says that in a determination on the ulnar nerve, Eulenberg and other observers simultaneously came to opposite conclusions. He attributes the inconsistency of the results to the inconstancy of the nervous matter, a view which was followed by many physiologists ; but it is rather hard to throw all the blame on the nervous matter. Every one of them assumes so much, and all their results are heterogeneous to the last degree ; there is obviously something wrong somewhere. I have felt that for a considerable time, but now I hope we are on the way to see what is wrong. I do not in the least deny that an action does take place such as that which is called electrotonus ; but too much stress has been laid on physiological points, and the investigation has been conducted without looking to see that the physical agent is constant under all conditions, and acting under the same circumstances. For instance, Rosenthal lays much stress on anode and cathode, though anode and cathode are purely fictitious terms. We consider that the current goes from the anode to the cathode, but we have no means of knowing that it does ; it may go the other way. We call the one plus and the other minus, and we have entirely to assume the upward and downward movement, and the influence of the two poles. This is the first assumption. But we do know something else about the two terminals by electro-chemistry ; we know that at the plus terminal in an electro-depositing apparatus oxidation takes place, and that at the minus terminal hydrogen comes off, and is there deposited. We know in this way that if we are not working for the deposition of metal, but take a different body, we have a secondary battery, and I have not the smallest doubt from these observations that these effects are the effects of electro-chemical decomposition. No doubt that chemical decomposition will transmit excitement along the nerve and make the muscle contract, and the inconstant results obtained in that way are due to chemical decomposition of a polarisation kind. There is the more reason to believe this, because we are always finding in books such phrases as these, which are thoroughly unscientific : "When the currents are weak the neutral point lies nearer the anode ; when they are stronger it is situated nearer the cathode. When the currents are of a certain medium strength it remains at an intermediate position—that is, exactly midway." What is medium strength ? I want it in some physical measure—in ampères. You do not get that anywhere. What we do know is that the medium strength, where the balance is maintained, is the strength which exactly balances the counter E.M.F. of the body, and that is somewhere below a volt. When you get up to two volts you see that the electro-decomposition is clear enough. The certain medium strength which ought to be measured, and which must be measured, is the balancing E.M.F. of the body.

The currents used as a rule by Du Bois-Reymond are infinitely too strong for accurate determinations. He speaks of using 11 or 12 Grove cells, but I should be very sorry to pass the current from them for any length of time through a patient without great precautions. An accident might occur, and in fact in the case of the Comte du Moncel an accident did occur, and Du Moncel only used 8 Daniells, which is about 8 volts, whereas 11 or 12 Groves would be about 29 volts. I think I ought to read, as I might otherwise be misrepresenting Rosenthal, who is a very able man, and one of the great electricians of the German school—I should read his admission, frankly made, that the currents are inconstant. He says :—"If a continuous current is passed through a nerve and is alternately closed and opened, the excitement appears to grow irregular, sometimes at the closing and sometimes at the opening of the current, and occasionally even at both."

There is another error which runs through the physiological observations, and that is what is called the tetanising key of Du Bois-Reymond, which is a short circuiting apparatus, putting a good conductor in the course of the current and, as is supposed by physiologists, entirely cutting off the electrical agency from the larger loop of the conductor tested. But it does nothing of the sort. The law of double circuits is that the currents are divided in the inverse proportion of their resistance ; but there is no law that the resistance in a large circuit is ever completely stopped by Du Bois-Reymond's key.

That Du Bois-Reymond key has been, I believe, another source of error and inconstant effects. In fact, Rosenthal, who was a distinguished pupil of Du Bois Reymond, speaking of the key, says : "The lever is made short and thick, and, being made with a short, thick piece of brass, which offers hardly any resistance, while the muscle has great resistance, the current passes nearly all through the key." This is not a scientific or a satisfactory arrangement. It should be none or all. When we add to the constant current the induction coil the problem becomes infinitely more complicated. And when we add, as some observers have done, the continuous and induced currents to one another, in the same stream, I am quite certain that the problem is physically past solution. They have even done more than that. There are induction coils now made in which the current of the primary is transmitted through the secondary complex circuit in

that way, and then the continuous is added on, all unmeasured, piled on the top of one another, and no wonder the effects are inconstant. One does not know which way the current will run, nor which predominates over the other.

Next comes a most distinct false assumption, which I hope to prove to you at the next lecture ; and here I may be doing Drs. Waller and de Watteville an injustice if I do not read the following passage. He speaks of using a constant current and an induced current as the mode of producing electrotonus. He says, respecting the testing current, whether galvanic or induced : "Since the laws of diffusion are the same for both." I do not believe the laws of diffusion are the same for both, and the fact upon which I found that belief I shall demonstrate to you at the next lecture, for whereas my patient gives 1,100 ohms resistance to the constant current, even when corrected for polarisation, to the induced current he only gave half that. I discovered this remarkable fact some little while ago. An induction current will pass through the body and give only a resistance of about one-half to two-thirds of that under a constant current, even when corrected in every way for polarisation. Here is a case where it is curious to observe what happened. The patient gave a resistance corrected by Mance's method of 1,150 ohms—it really came out a little below that, but we will call it 1,150. With an interrupted current he gave a resistance of 575, the exact figures being 1,141 against 575. It is very nearly two to one. Therefore the laws of diffusion, I say with confidence, are not the same for the two. What may be the cause of the difference I am not quite prepared to say at length, but it is clear that this fact must have a physical origin. I will take that up more largely at the next lecture.

I mentioned at the last lecture that we have in the telephone an instrument by which we can reproduce physically many forms of testing machinery which were formerly of a physiological character, and the observation is so interesting that I shall ask you to allow me to go a little more fully into it to-day. I have an interrupter here with which I can make and break a current at different paces ; and here you will be able to discover that the result is not only audible, but if you listen to the telephones about the room carefully you will hear that the ticks given by one and the other act are considerably different. There comes a period, if I slide the sledge along, when the tick of making contact disappears. It goes gradually down and fades out. The one tick fades away and leaves the other. This is exactly what has been shown in galvanoscopic frogs, as a means, as it is said, of getting pure excitements. But it is nothing more nor less than what is due to physical action. This can be done without a frog, at a distance, with a telephone replacing the frog. Therefore, I hope I have carried conviction to you.

To me it seems very plain that what Dr. Waller admits when he says that we are dealing with physiological signs alone has been a somewhat dangerous course of action, and that that error has arisen from not measuring our instruments more carefully, and that the prospects of advance in this direction will be by building up from the foundations ; by ascertaining what is the force we are using, and how it acts ; and then on the top of that to put the physiological determinations. Many of the observations that have been made—and they are very exhaustive (even Du Bois Reymond's volumes alone are the work of a lifetime)—are very interesting, if not convincing. There is another point which has stood in the way of accuracy, and that, I may note, is that over-sensitive galvanometers have been employed. The delicate Thomson galvanometer, beautiful instrument as it is, is so very sensitive that it requires to be very heavily shunted, or you can hardly handle it. The same thing applies to the galvanoscopic frog. We have no means of calculating the accuracy of that. Probably no two prepared frogs have exactly the same power, neither do I see any way of obtaining it. It used to be said we moved up from electroscopes to electrometers when Sir Wm. Thomson discovered the method of measuring in real units. We want to move from galvanoscopes and from physiological shades of action to those which will measure physical units with accuracy. I have great hopes that the telephone will be of service in this way. The telephone is an exceedingly delicate instrument, so very delicate that it almost has the fault of delicacy : but we have the power of improving it, and I will show you at the next lecture that we can use it so that it will take the place of a galvanometer in the ordinary Wheatstone bridge, if you will only interrupt the current ; but not in the way in which it is interrupted in an induction coil, but by a small chronometer. Then by our interrupted current the telephone gives a tick and it can be silenced when the two resistances are equal, as in the usual case of the Wheatstone bridge, provided, however, that the two currents are equal in self-induction. The beautiful new instrument of Prof. Hughes not only measures by means of the Wheatstone bridge, but, using the telephone as a galvanometer, measures resistance and also the self-induction. I find that these physiological substances exhibit a very considerable amount of self-induction. The double-wound coils reduce self-induction so much that you can almost take it for nothing ; but there is even a better plan suggested by Lord Rayleigh, although it was originally theoretically produced by Clerk-Maxwell—that is, coiling two wires side by side, make one of them a closed circuit, passing the current through the other ; in that case you reduce the self-induction to nothing, and that I expect will be the way in which we shall be able to measure the self-induction of compact bodies like the human body. In the meantime, I feel sure that much that has hitherto been done will prove to be purely erroneous, that the investigations, although laborious, have been greatly misunderstood, and, in some cases, ingeniously misinterpreted.

THE STRANGE HISTORY OF A DYNAMO

As told by itself to

A. DYNAMICABLE.

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(*Continued from page* 376.)

NOW when the electro-magnet turns, its two branches become alternately magnetised in contrary directions under the influence of the permanent magnet, and in each bobbin an *induced* current is produced. The wires on these respective bobbins *are coiled in such a manner that the two currents help one another, i.e., they both flow in the same direction.* Let us follow the bobbins through one revolution, bringing to our aid a diagram which will materially assist us in our understanding.

We will assume that the bobbins are rapidly turning, and that they have arrived at the position I. Coil A is leaving the N pole whilst coil B has just come upon the S pole of the permanent magnet ; thus a current is produced, say, of a *positive* sign—alternating currents are generally said to be *positive* and *negative*—in both coils.

In position II., coil A is approaching the S pole, and coil B is just over the N pole of the permanent magnet, the current in both coils being the same as before.

Thus you see in half a revolution of the electro-magnet we have two currents induced in the coils of the same character.

You think the impression might prevail in the minds of the unscientific portion of our readers that the currents should have been in opposite directions, or alternating ?

Perhaps it may, for I fancy I omitted to say that whether a given coil *approaches* the N pole or *recedes* from the S pole of a magnet, the current induced therein is the same.

You agree with me that this has made the dubious

point clear? Well, we will now proceed with the remaining half revolution, which will complete our cycle of operations.

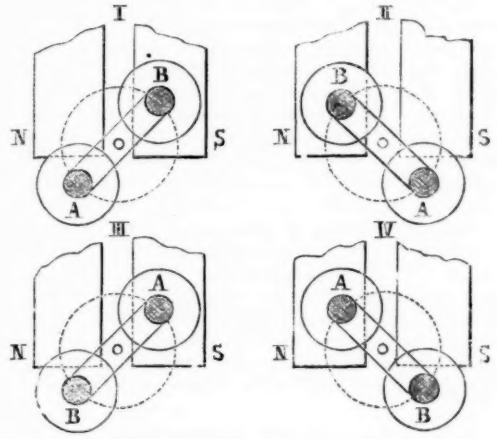


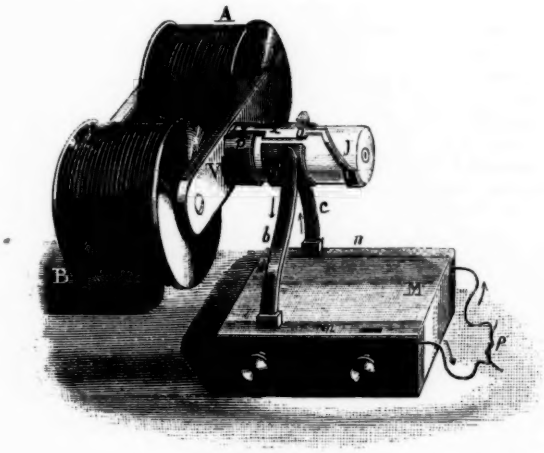
DIAGRAM ILLUSTRATING THE PRODUCTION OF CURRENTS.

In position III. the coil, A, has become uppermost whilst B is underneath. You perceive, therefore, that both portions of the electro-magnet are reversed as compared with I., and you can with certainty conclude that the currents are now also reversed, or *negative*.

The same is seen if we compare II. and IV., therefore we find that during the complete revolution of the electro-magnet we obtain four currents, or electrical impulses of an intermittent nature, two being in one direction (*positive*), the other two in the reverse direction (*negative*).

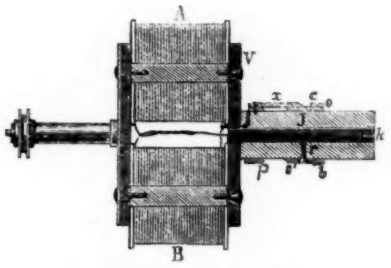
I hope this will be clear to all who may take an interest in me and my doings in the past, present or future; and now to show how these alternating currents —which for some purposes answer well enough—may be commutated so as to pass always in the same direction.

You did not think the commutator on the Pixii machine large enough to enable us to clearly observe its action, and I promised you an enlarged one for the purpose we have in view. It is this—



COMMUTATOR.

The apparatus consists of a cylinder J, made of insulating material, such as wood, ebonite or ivory, and through which runs a copper cylinder of smaller diameter fixed to the armature, V, and turning with the bobbins or electro-magnets, A, B. On the insulating cylinder is first a metallic (brass) ferrule, *p*, and in front of it two half ferrules, *o* and o^1, also of brass, and completely insulated from one another; *o* is connected metallically with *p* by a tongue, *x*. On the sides of a base of wood, or other insulating substance, M, there are two brass plates, *m*, *n*, to which are attached two flexible springs or rubbers, *b* and *c*, which press successively upon the half ferrules, *o* and o^1, during the time the bobbins are in motion. Now upon glancing at the sectional view of the commutator it will be seen



SECTION OF COMMUTATOR.

that two ends of the coils of the electro-magnets (in the same direction with respect to the currents passing through them) terminate in the metallic cylinder, *k*, and by means of the screw, *r*, are connected with the half ferrule, o^1; while the other two ends—both in the same direction with respect to the current—are in connection with the ferrule, *p*, and also, therefore, with the half ferrule, *o*, through the tongue, *x*. It follows that *o* and o^1 are the terminals or poles of the alternating currents, which are developed in the bobbins, and, as we have already explained, they must therefore be alternately *positive* and *negative*.

If we now assume a case in which o^1 is *positive*, the current descends by the spring, *b*, goes through plate *m*, and by a connecting wire, ρ to *n*, whence it ascends, *c*, and is closed by contact with the piece, *o*; then, as rotation goes on, *o* takes the place formerly occupied by o^1, thus keeping the current in the same direction, for, as it is then reversed in the *bobbins*, *o* has become *positive* and o^1 negative, and thus it continues so long as the bobbins are turned.

With the springs, *b* and *c*, alone, I must tell you, the currents from the two pieces, *o* and o^1, could not unite unless *m* and *n* are joined by the wire, ρ. The same result, however, may be obtained by means of a third spring, which I brought before your notice in Clarke's adaptation of my Pixii form, and of two connecting pieces not distinguishable in that figure, but one of which, *i*, can be traced in the foregoing view of the commutator. These two pieces communicate respectively with *o* and o^1, and, as often as the third spring touches one of them, it comes in contact with spring, *b*, and the current is closed between the two springs and then reaches *c* by means of the plate, *n*.

Well, it may not be altogether so easy to follow me as I had anticipated, and, indeed, I am not sure but that I have gone beyond my original intention when I singled you out to act as my mouthpiece. It might have been best to make the simple statement that currents of alternating character or opposite sign can be changed into continuous ones by means of a simple apparatus called a commutator. However, it is useless to regret it; the thing is done. And now to continue my historical career.

(*To be continued.*)

Electric Light Plant Burnt Out.—Mexico, Mo., will have to do without her electric light, for a while at least. About 12 o'clock midnight, on the 9th inst., the engine house situated in the rear of the business houses on the west side of the square was discovered to be on fire, and not until everything in the building was ruined were the flames subdued. In a few moments two streams of water were playing upon it, and as a result the whole west side was saved. About twenty lamps were used in business houses, besides the public square being lighted by it.

C

ABRIDGMENT OF THE NORWEGIAN PATENT ACT OF JUNE 16th, 1885.

UNDER this Act (which came into force on January 1st, 1886) patents are granted for new and useful inventions, medicines and articles of food being, however, excepted, but patents may be obtained for the process or apparatus for producing such products.

Each application for a patent (which must be limited to one invention) is subjected to examination by a Patent Commission. If the papers are not in proper form, time will be allowed to amend them, but if the alleged invention is manifestly wanting in novelty, or otherwise unpatentable, the application will be refused. If, on the other hand, the application be accepted, it is advertised and the documents are made public by being thrown open to inspection. (This publication may be delayed at the request of the applicant on payment of an additional fee). Opposition may then be entered during eight weeks. The Patent Commission has then sixteen weeks within which to come to its decision.

Should the applicant be dissatisfied with the decision of the Patent Commission, either in its preliminary or final examination, he may lodge an appeal within six weeks, and in the event of the result of such appeal not being satisfactory, he may enter a second appeal within four weeks.

Should the decision after the lapse of the period for entering opposition be favourable to the applicant, a patent will be issued forthwith.

The application for a patent must be made within six months of the invention having been published by printing or public exhibition; the inventor is, however, bound to make it known when he publishes the invention that he intends to apply for a patent for it.

The first inventor, or a person deriving authority from him, is alone entitled to a patent, but where, in the case of there being several applicants in respect of the same invention, it cannot be ascertained which is the first inventor, the patent will be granted to the first applicant.

For a period of two years following the date of the patent, the patentee has the exclusive right to protect improvements on his patented invention by a certificate of addition terminating with the original patent.

The duration of the patent is fifteen years from the date of the application, subject to the payment of a small annual tax, which is progressive. The tax may be paid three months after it becomes due, with a fine.

The effect of the patent is that no person, except for his own use, shall, without the consent of the owner, make the patented object, or import it from abroad, nor shall sell or even negociate for the sale thereof.

When the subject of the patent is a process, an apparatus, a machine, a tool or other implement, the patent has further the effect that no person without the consent of the owner of the patent shall use the invention in his business. This provision will not, however, operate to prevent the use of objects relating to navigation on ships bound for a foreign port but stopping in Norwegian waters.

The patent will, further, be inoperative against any person who, prior to the patent application, may have used the invention in Norway or made the necessary preparations for such use.

A patented invention may, by decree of the King, be used in the public service, likewise where it is of essential importance to one or other of the branches of trade connected with articles of food, it may be thrown open to private persons. In either case the owner of the patent will receive compensation, which, in default of agreement, will be settled by arbitration.

The invention must be worked in Norway, or the patented object placed on sale there, within three years; and such working or placing on sale must not be subsequently interrupted one year. This last-named term may be extended by the Patent Commission for special reasons. The Patent Commission will, in special cases, give directions as to what is required for the working or placing on sale.

There are ample provisions for dealing with infringements, the infringer being required to compensate the patentee for any damage he may have caused him, and, further, where the infringement is intentional, being mulcted in a fine and liable to have the infringing goods confiscated.

A year is allowed from the January 1st, 1886, for the owner of a patent granted under the old law to exchange such patent for one issued under the new law, subject to the result of the official examination, in particular as to novelty at the date of the original patent.

Norway is a party to the International Convention so that an English patentee will have six months within which to apply for a Norwegian patent for the same invention. T. J. HANDFORD.

The Philadelphia Pole Tax.—Judge Hare, of Philadelphia, has rendered an opinion respecting the decision of the referee in the suit brought by the city against several telegraph and telephone companies to recover the license fee of $5 upon telegraph poles, that the fee was excessive, could not be sustained, and referred the case back to the receiver for reconsideration.

NOTES.

Ship Lighting. — The finely-modelled steel screw steamer recently launched from the yard of the Sunderland Shipbuilding Company, Limited, and built to the order of Messrs. Welmer, Ashton & Co., of Manchester, on behalf of Senor Joaquin Redo of Mazatlan, Mexico, is fitted with the electric light, the main saloon being brilliantly lighted. A separate electric light is also provided for each berth. The second class saloon and berths, together with both officers', engineers', and crews' accommodation, as well as the engine room, stokehole, and other parts of the vessel, are also lighted in the same manner. The electric machinery is by the well-known firm of Messrs. Siemens Brothers, and fitted by Messrs. Dorman and Smith, of Manchester.

The Grangemouth Dockyard Company has secured the contract for the building of two screw steamers. They are intended for the passenger trade in the East, and will both be fitted with the electric light throughout.

The Electric Light and Gas in America.—A comparative statement just published shows that New York has 23,038 gas lamps and 647 electric lights; Boston, 9,781 gas lamps and 401 electric lights; Baltimore, 5,191 gas lamps and 243 electric lights.

Electricity in the Navy.—A permanent electric staff is to be formed at Chatham Dockyard, where a certain number of the best fitters in the factory have been selected to be sent to Portsmouth yard for instruction in electrical work, with the staff at that establishment. On the fitters completing their course of training at Portsmouth they will return to Chatham, and form the nucleus of a permanent staff of electricians at that establishment.

Electric Lighting in California.—The Jenney Electric Company, of Indianapolis, has commenced the lighting of the enterprising city of San Diego, Cal., this being the first plant installed on the Pacific Coast by the company named. The contract runs for five years, and is for four towers, the price being $1,200 a year per tower. So much satisfaction, however, has been felt with the light that an additional tower has been ordered, whilst it is stated that there is a probability that still more will be required. Each tower is equipped with six 2,000 C.P. lamps. The local gas company had been charging $5 per 1,000 feet for gas, but when the electric lighting commenced, reduced the price 20 per cent. In addition to the city lighting the company has subscribers for 30 private lights at the rate of $15 a month each. As yet only arc lights have been introduced, but the company proposes also to supply incandescent lights for its central station, and will, it is stated, have these in operation in about two months. The station has three 30-light dynamos, and a Buckeye engine of 70 horse-power.

Electric Effects on the Stage.—One of the newest and most successful effects with electricity on the stage is that introduced by the Stout-Meadowcroft Company for the American Opera Company in New York. It is known as the "Firefly." Fine, invisible wire is suspended across the stage, and connected with a large spark coil and 24 "luminous points;" and the passage of the current causes an instantaneous flashing of the points all over the stage.

Electric Lighting of a Parisian Library. — The library of the Conservatoire des Arts et Métiers is to be lighted by electricity. It is the first Parisian library which will enjoy this advantage. The inauguration takes place this week, on the occasion of the meeting of the several scientific congresses, which generally assemble in Paris during the week following Easter.

Electric Lighting in Speyside. — Writing to the *Scotsman* last week, a correspondent gives a description of the system of electric lighting introduced in Doune House, Rothiemurchus. He says the water-power available has been used for this purpose. The wooden building—15 by 10—which contains the dynamo and turbine is situated about three-quarters of a mile from the house, and the current is conveyed therefrom to the 18 accumulators, which are placed in an outhouse in the courtyard of the house. Advantage has been taken of the house main water pipe to effect considerable economy in wire, it having been utilised for a length of about 1,000 yards as a return. The turbine, which is of 2 horse-power, works with a head of only 10 feet of water, the necessary speed for the dynamo being obtained by means of a countershaft. The machinery is started about an hour before the lights are required, and continues running without attention till 7 a.m. the following morning, when it is stopped, unless a very large number of lamps have been lighted for an unusual length of time, in which case the dynamo is run until the accumulators are again fully charged. The total number of lamps, which are of 10 candle-power each (Swan's incandescent), is 100, of which 50 to 60 are lighted nightly, and the dynamo being run at the same time, prevents an undue drain upon the accumulators when on special occasions all the lights may be used. Safety fuses are placed in every direction, so that there is absolute immunity from all risk of fire. The entire installation has been carried out by the engineer, with the assistance of two local carpenters—one working all the time, the other for a few weeks as well. Both are exceedingly intelligent young men, and the management of the machinery and accumulators, &c., is now entirely in their hands. The cost of the electric installation has been £400, including carriage of plant to this distant spot. The cost of lighting this house the year round hitherto has been £70, colza oil having been used in preference to mineral oils, to lessen risks of fire. The estimated yearly cost in the future is £25 for renewal of lamps, brushes for dynamo, machinery oil, and chemicals for re-charging accumulators. The saving of work in cleaning and preparing lamps is considerable, and the coolness, cleanliness, and brilliancy of the new mode of light is much appreciated by the household.

The Poet and the Electric Light.—The advent of the electric light in San Diego, where it was introduced by the Jenney Electric Company, was hailed by the local poet in the following terms :—

Tell me, Mr. "Jenney" man,
How you "strike" a light;
Do you climb those iron poles
With your matches every night?
I know the climb-it here is good;
But is that the way you do?
Tell me, Mr. "Jenney" man,
For I wish I knew.

Tell me, Mr. "Jenney" man,
Will it be very bright?
And who is this "smart Aleck"
That got up this Aleck trick light?
Surely he's a Boston man,
And cultured very high;
Tell me, Mr. "Jenney" man,
Will he be here by-and-bye?

Tell me, Mr. "Jenney" man,
Will it shine just like the moon?
Will we have to light a lamp
When we go into our room?
Will we have to take a lantern out
When to church at night we go?
Excuse me, Mr. "Jenney" man,
But all this I'd like to know.

Electric Lighting Act Committee. — Mr. W. H. Massey, electrical engineer in the Royal Household, has retired from Lord Thurlow's Committee, in consequence of the action taken recently by the executive council with reference to the Bills now before the House of Lords.

Liverpool Exhibition.—The Liverpool Electric Supply Company, which secured the contract for the lighting of the Shipping Exhibition throughout with the electric light, has arranged with Messrs. Walter T. Glover & Co., Salford, Manchester, for the supply of all the electric light cables and wire.

The Telephone on Lightships.—The lightship anchored about ten miles off Walton-on-the-Naze, in the Swim passage, is now in regular telephonic communication with the town. The name of every ship is telephoned to the Walton post-office, and some 90 craft pass the lightship every day. One rough night a vessel got on the sands, and the lifeboat was telephoned for, but was subsequently stopped by telephone when about to start, because the craft eased off, and a night of exposure was thus saved to the lifeboat crew. The cable has once been broken, but was re-united within 24 hours.

The Telephone at the Law Courts.—Arrangements are in progress for the opening of a telephone office at the Royal Courts of Justice for the convenience of barristers, solicitors, and other subscribers who may have business there. The office, which will be situated on the North Court corridor, between the Lord Chancellor's Court and Chancery Court III., is expected to be completed very shortly.

Guthrie's Telephone.—A contribution to the telephone controversy in America comes from Leesburg, Ohio, where it is reported that Mr. J. T. Guthrie experimented on the transmission of speech by electricity long before Bell received his now famous telephone patent of 1876. It is stated that Mr. Guthrie has now perfected a new form of telephone quite different from any previous device. A patent has recently been granted to him for a telephone which is operated by a direct instead of an induced current of electricity.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to April 24th, 1886, amounted to £60,000, against £65,000 received from April 1st to April 25th, 1885.

The Singapore-Penang Cable.—The ss. *Seine* started on Monday week to lay a new section of cable between Singapore and Penang.

Cable Inspection.—We hear that the ss. *Volta* is now engaged in picking up and examining the first direct Spanish cable, the condition of which is reported to be doubtful. The bottom which is found off the north coast of Spain is irregular, and subject to submarine landslips, and it is a pity that, when this cable was duplicated, the company were content with changing the types of cable, instead of changing the route. That no real improvement was effected is proved by the fact that the new cable broke down within a year after it was laid; whereas, if a new route had been chosen, this cable might still be regarded without anxiety.

The Rate-cutting War.—Acting in sensible fashion, the Commercial Cable Company has decided, we learn, not to reduce its tariff to the low charge of 6d. per word for the transmission of messages between the United Kingdom and America, which the other Atlantic cable companies, acting in concert, have adopted, but to reduce only to 1s. per word, trusting that the public will support it upon the strength of its past work in procuring a reduction from the rate of 2s. per word. No doubt the bulk of the trans-Atlantic traffic will fall into the hands of the combination, whose cables will in all probability become congested. Those who wish speed and certainty for the transmission of their messages will, in this state of affairs, undoubtedly pay the additional 6d. per word, and it must be remembered that only half the proportional amount of traffic will be required to produce the same monetary result.

The following circular has been issued by the

Commercial Cable Company (Mackay-Bennett cables): "We beg to inform you that on and after the 5th prox., until further notice, the rate for telegrams by this company's cables to all points in the United States of America, Canada, &c., will be reduced to 1s. per word. The 'pooled' Atlantic cable companies, consisting of the Anglo-American, Direct United States, French, and Western Union, have made strenuous efforts to induce this company to raise the tariff to 2s. 6d., and as we have refused to accede to their wishes, they announce a 6d. rate. It is known full well that this rate would result in a serious loss to all the companies, but the 'pooled' companies think by adopting this extreme measure, the Commercial Cable Company will be forced to come to terms, and raise the price to the figure desired. The Commercial Cable Company commenced business at 1s. 8d. per word, being a reduction of 20 per cent. on the then existing charge, and the amount of patronage we have received proves that the rate is a popular one. It was the intention of the Commercial Cable Company to regard 40 per cent. as their maximum, gradually reducing the price as opportunity offered. The earnest wish of this company is to maintain the 1s. 8d. rate, and to this end we ask the public to make a temporary sacrifice by supporting us at 1s., on the assurance that if we are vigorously backed up now the tariff shall return to the original figure, viz., 1s. 8d."

It is unfortunate that at this interesting juncture the Duxbury section of the French Atlantic cable is reported as broken down, for this will doubtless add to the difficulty which the "pooled" cables will experience in dealing with the increase of traffic which may be expected.

It will, to a dispassionate observer, be interesting to watch the shearing of that lost sheep, the "Anglo" reserve fund. Can it be that the heroic band of shareholders, who are the property of the combined companies, are not only defending their own interests but are also attempting to cripple a company which may otherwise take a leading part in uniting the Australian colonies with England, by the proposed Sandwich Island, &c., route (which was referred to by Mr. J. Pender at the recent meeting of the Eastern Extension and Australasian Company)? If this be indeed the case, the Eastern and allied companies ought to be deeply grateful for an attention, which, while it is coincident with their own interests, has the additional merit of costing them nothing.

Killing Dogs by Electricity.—The Kimberley Borough Council, on the recommendation of its electrician, Mr. R. L. Cousens, recently resolved that in future all dogs that were captured without license ticket, and no owners appearing to claim them, should be dispatched by means of electricity, as the method of poisoning, used previously, was by no means effective, the brutes frequently lingering from half-an-hour to two hours before death ended their misery. The dogs are put into boxes, which can be opened at each end, at the bottom of which are fixed, on insulators, two copper plates, separated from one another by about three inches, so that the fore feet of the dog may rest on one plate, and the hind feet on the other. To the copper plates are fastened two wires which lead to two switches hanging on the wall. One of the Brush machines, which lights twenty-three of the lamps during the evening, is connected with the switches. The copper plates in the box are moistened with salt and water, in order to secure better contact between the paws of the dog and the plates; the dog is put into the box, the ends being closed, then when the fore-paws are on the one plate and the hinder ones on the other, the switches are closed, and the machine is short circuited. The moment the short circuit is taken off, the current goes through the body of the animal, and it is instantaneously killed. The only time taken up is in the act of putting the dogs into the boxes and taking them out again. On one occasion 23 dogs were killed in less than the same number of minutes.

Great Blasting Operation.—A recent account of the progress of the works which the London and St. Katharine Dock Company commenced in 1884 for the enlargement of the Tidal Basin of the Royal Albert Dock and the formation of a new entrance suitable for the increased draught and dimensions of new ocean liners, stated that the solid concrete wall which bounded the basin on its north-east side was being prepared for blasting away. Last Friday morning at six o'clock the great blast was successfully performed. The wall, reduced in thickness to four feet six inches at the top and at the bottom to six feet, was pierced with 1,430 holes about four feet apart, and these were loaded with charges of gelatine dynamite varying from 8 lbs. at the base to ¾ lb. at the top. All these charges were put in at the back of the wall, its front remaining intact supporting the water of the basin. The total length of the wall was 520 feet, and the estimated weight of material, flint, and pebble concrete, 7,850 tons. The electrical wiring for the simultaneous discharge of this multitude of shots was carried out by Messrs. Siemens, who have the lighting of the Docks, the plan of operations having been submitted by the Dock Company to Sir Frederick Abel. One of the alternating machines used for shed lighting, and in its ordinary working giving off a current of 48 ampères at 600 volts, was coupled up in series to develope a high tension current of 24 ampères at 1,200 volts, to suit it for firing the high tension Abel fuzes which were to be employed on the occasion, this being the first time that such a large number of this class of chemical fuzes have been employed, platinum wire or low tension fuzes being usually adopted for this kind of operation. Two well insulated main leads of copper wire were brought from the ordinary electric lighting station beyond the Galleons Basin, and were carried along the rear of the wall. Two additional mains were also carried from the machine and united with the first mains about the middle and at the end of the wall, so that if any damage or defect occurred at any point in the transmission of the current it would have independent means of percolating the network system of branches which were taken off from the mains to the fuzes. The transmitting mains were tapped at the firing station, erected near the bridge, at the western extremity of the basin, by a tumbler-switch, by a blow upon which the electrical current could be instantaneously put into circuit. The total length of branch wires was over six miles, and the total quantity of gelatine dynamite employed was stated to be 2,860 lbs. Six feet of the wall was above the level of the water in the basin. The operation was performed in the most successful manner, and upon inspecting the site of the blast, it was found that the wall had completely disappeared, except half a dozen large blocks, one about four feet long, which had been thrown about 20 feet, and lay on the road. The divers at a later period reported that the material had been reduced to small masses not exceeding a ton weight, and smaller on the average.

Alleged Libel on Mr. Hugh Watt.—At Westminster Police-court last week, Mr. Richard Fyfe, 40, an engineer, of Moreton Terrace, Pimlico, was charged on a warrant with publishing a malicious and defamatory libel of and concerning Mr. Hugh Watt, M.P. Mr. Tickell, barrister, appeared for the prosecution, the prosecutor not being in attendance. The sworn information disclosed the following facts:—The prosecutor is a merchant in the City of London, and chairman of the Maxim-Weston Electric Company, Limited. At the end of March last the defendant, who had been in the employ of the company, was summarily dismissed, and not only the prosecutor, but others had received very scurrilous letters and communications, those addressed to the prosecutor reflecting on his conduct not only as a director of a public company, but in his private capacity as a citizen. Two of the directors of the company, Messrs. Louis Swabey and John Brown, had received letters from the prisoner at their private residences, and these letters had been handed over to the prosecution. One of the letters was couched in the

following terms :—"I was never locked out of my house and my wife gone, the brokers in charge of a house on the hire system. I am a gentleman. Richard Fyfe. Copies forwarded to your constituency, feather directors, shareholders, &c. Act at once, R.F. You will very likely pay my claim. I am in possession of a paper proving Watt a liar, signed by two shareholders. Richard Fyfe." Sergeant Edwards, the chief warrant officer of the Court, proved the arrest of the defendant, who stated that the prosecutor had sent him a letter threatening him with seven years' penal servitude, and he had consequently called him a liar. Mr. Partridge asked if defendant showed any letters. Edwards replied in the affirmative ; the letters the defendant produced he stated he had received from the prosecutor. On the way to the police-station he said that he had been to Glasgow during the late election, and was there for six weeks, at great personal expense, furthering the interests of the prosecutor. He also added that he had been instrumental in causing the return of the prosecutor to Parliament, and that the treatment he was then receiving was his reward. Mr. Tickell asked for a remand, as the prosecutor was not present. The defendant observed that in his opinion, it was very unfair to apprehend him early in the morning without any notice, especially as documents now in the hands of his solicitor would explain everything. He could produce one letter from the prosecutor containing a deliberate threat. Mr. Partridge observed that even were that true, there could be no justification for libelling the prosecutor. There must be a remand, but bail would be accepted in £30. Bail was immediately put in, and defendant left the court with his friends, stating excitedly that he would expose the prosecutor.

Mr. Fyfe has since taken out a cross-summons against Mr. Watt for libel.

The Norwegian Patent Laws.—In another column we publish an abridged translation of the new Norwegian Patent Act. The Scandinavian countries are greatly improving their patent law, Sweden having taken the lead about 18 months since. Denmark is too much distracted with political complications at present to give us much ground for hope that the much needed reform in its patent law will be accomplished for some time to come. We believe there is a good field for electrical inventions in the Scandinavian States, so probably anything bearing on the protection accorded to inventors in those States will be of interest to our readers.

Electrical Dissipation of Smoke.—Professor Oliver J. Lodge concluded a highly interesting lecture on "Fuel and Smoke" at the Royal Institution recently by showing the effect of an electrical discharge upon dust or smoke. A bell-jar, connected with a frictional machine, was filled with smoke. Two turns of the generating machine was sufficient to clear the jar of all the smoke. On the electrical discharge passing through the jar the smoke coagulated and deposited itself on the bottom and sides of the vessel in snow-like flakes. What might be the development of this peculiar power of electricity Professor Lodge said he did not know, but he felt that something ought to come of it. Certainly lead fumes and other similar nuisances arising from industrial processes could be condensed and got rid of by means of this process. At the close, Professor Lodge intimated that he would deliver a lecture upon this application of electricity at the Royal Institution next month.

That Lineman. — The invasion of private property by linemen has caused serious complaint in this country as well as in America, therefore the following story from that country of one party's experience will not be uninteresting :—"You know where my place is ? Well ; under the sidewalk in front I heard some pounding one day, and went down to investigate. Two of the worst looking men I ever saw outside a penitentiary were taking out a huge stone to bring through an electric light wire. I stopped them, and sent them off packing. I gave orders to my help under no circumstances to let them into that area again, and I had a lock put on the door. A week afterward I had occasion to go there, and bless my spectacles if they hadn't picked a hole through on either side of me, fished their cable through my premises with a hooked wire, and had the lamps running over a week before I found out that I was burning lights on that same circuit ; but my loop came down from the roof. Well ; I caught a telegraph man on my house. The health people had ordered a ventilator, so I put up a wooden shaft three stories high, and in less than 24 hours this critter had found it and was putting in a ticker line down my shaft. I afterward found a wire which had pulled down half a chimney, and there was no telegraph, telephone, ticker or district company who would own it. As the wire was what all these fellows called a 'dead' wire, I cut it. When the owner came, about half an hour afterward, bless me if it wasn't one of my old friends the electric light men, who had been bounced for not going through my area, or rather for getting caught and stopped, and was now working on over-head wires. I expect all telegraph men will get to heaven. If they can't climb the wall they'll go under it."

Electric Light v. Gas.—In Chester, Pa., the fight between electricity and gas has resulted in the reduction of the price of gas from $2. to $1.70 per 1,000 feet. The gas company has offered to let the city have gas at $1·50, if 250,000 feet is burned. It is understood that the electric people will offer to light the city all night for a reasonable advance on what is now paid for light until twelve o'clock.

Longfellow on Lightning.—In the life of Longfellow, just issued, the following happy little passage is quoted from his diary :—"Lightning is a ferocious visitor when it comes to a man's house, bursting in so unceremoniously, yet ringing all the bells to announce his presence, and away again after shaking hands with the inmates and dancing wildly on the bell wires. A kind of Robin Goodfellow with his ho ! ho ! ho !"

Atmospheric Observations.—An interesting series of observations were recently made by gentlemen connected with the United States signal service simultaneously at Boston, Columbus, O., Washington, D. C., Ithaca, N. Y., and at Yale College, New Haven, Conn. The observations at Boston were taken in the basement of the new building of the Massachussetts Institute of Technology. They were continued at intervals of five minutes during a period of 72 consecutive hours. The observations, which were taken by means of the electroscope, were for the purpose of ascertaining the variations of atmospheric electricity and humidity, during the period named. The object of taking the observations simultaneously at different points throughout the country was for comparison, in order to ascertain whether the varying atmospheric conditions are similar throughout the country or are simply local. It is believed that the results of the observations will be of great value to the signal service in the prognostication of storms, and it is hoped that by this means some new laws of storms and atmospheric disturbances may be discovered.

Telephoning from Moving Trains.—The discussion over the "air telegraph," of which recent trials have been made with much success, is, states the New York *Electrical Review*, still prominent in telegraph and railroad circles, where all imaginable claims and prophecies are made for this new discovery of the extent and force of induction. Yet it can hardly be called a new discovery, for the first patent (No. 247,127) was issued to W. W. Smith, now of Kansas City, Mo., on September 13th, 1881, nearly five years ago. About a year ago, Mr. T. D. Lockwood, the electrician and patent expert of the American Bell Telephone Company, searched the records very carefully, and became convinced that the Smith patent was the very first in this particular field, either in England or the United States.

Electric Tramway Locomotion.—On Thursday night and Friday morning last week, the directors of the Electric Locomotive and Power Company, Limited, had a private trial trip in an ordinary tramcar drawn by one of the Elieson electric engines. It was the second engine built by the company, and carried 70 cells. The car was one of the ordinary large cars of the North Metropolitan Tramways Company used on their line to Aldgate. With the view of interfering as little as possible with the traffic, and also to avoid a crowd, the start was delayed until the last car had finished its return journey from London, viz., about one o'clock on Friday morning. The route was from Stratford Church to Stepney, and everything was done to put the engine to a fair test. The rails were not in the best order, in fact they were in some places undergoing repair. The route was of an undulating kind, and the rails were somewhat greasy from a slight rainfall. The result was of a most satisfactory kind. The journey occupied 25 minutes. The engine and car were lighted with electric incandescent lamps, and were perfectly under control. Several stoppages were made on the different gradients, and these, as well as the respective startings, were considered satisfactory. The gradients were:—Stratford Bridge, 1 in 27; Sewer Bridge, 1 in 48; Bow Bridge, 1 in 30; Bow Church, 1 in 30; Bow Station, 1 in 32.

Petroleum Engines.—In his article on electric lighting operations Mr. A. Hamilton-Church refers to a new petroleum engine as being placed upon the market. We have every reason to believe that everything claimed for this motor will be realised in practice, and that it must be largely employed in electric lighting.

Incandescent Lamps.—Mr. Arthur Shippey proposes to use 16 candle-power lamps taking about 1·7 watts per candle-power as the most economical and safe for small installations. Although he speaks of the lamps manufactured by his firm as being of this "happy medium," we ask permission to doubt his statements. Other portions of his letter are so palpably absurd that we must decline to publish further communications of the kind.

Cable Working.—It is not often in these days of electric lighting that suggested improvements in submarine telegraphy are forthcoming, or at all events made public. The article which we publish by Mr. Ebel will therefore be all the more appreciated by those who are directly engaged in submarine telegraph operations.

Self-induction.—The discussion on the recent paper of Professor Hughes bids fair to produce much desirable information upon a subject not yet thoroughly understood. No doubt great interest will be manifested in the professor's new apparatus.

The Weston Laboratory.—A description of Mr. Weston's electrical laboratory appeared in last week's issue of *Engineering*.

New Cable in South Australia.—Accounts have just reached us of the successful laying of a cable from Yorke's Peninsula to Althorpe's Island. It is stated that the new cable will not be of great commercial value, although it will be of service in apprising the public of the shipping traffic between the two gulfs. The cable is 8 miles in length, about 2 inches in diameter, and armoured with ten thick galvanised wires, each three-tenths of an inch in diameter. It was manufactured by the Telegraph Construction Company, and was conveyed to Port Adelaide in the *Orissa*. It was laid amidst general rejoicings in the commencement of last month.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Miners' Electric Safety Lamp Company, Limited.—An agreement, dated 19th ult., relates to the purchase by this company from Mr. Benjamin Nicholson, of 57, Coleman Street, the sole right to use, exercise, and work for mining purposes the following letters patent, viz., No. 489, dated January 31st, 1882, for "Improvements in electrical batteries for telegraphic, telephonic and other purposes;" No. 4,460, dated December 19th, 1882, for "Improvements in and connected with batteries for generating electricity;" also Nos. 10,002 and 11,521, of the year 1884. The purchase consideration is £99,903, payable in fully paid shares. Registered office, 10, Old Jewry, E.C.

United Telephone Company of the River Plate, Limited.—At an extraordinary general meeting of the shareholders in this company, held at 131, Wool Exchange, Coleman Street, on March 25th, it was resolved that the Articles of Association be altered as follows: "In article 68, the expression 'nine-twentieths' shall be substituted for the expression 'one-twentieth.'" This resolution was confirmed on the 9th ult., and was duly registered on the 20th ult.

Electric Locomotive and Power Company, Limited.—An agreement, dated 3rd inst., and filed on the 22nd inst., provides for the issue of 1,564 shares, to be considered as fully paid up, after £3 6s. 8d. per share has been paid in respect thereof. The capital of the company has recently been increased to £60,000 in £5 shares.

Electrical Power Storage Company, Limited.—The annual return of this company made up to the 8th ult. was filed on the 27th ult. The nominal capital is £200,000 in £1 shares. 147,450 shares have been issued and are fully paid up.

Electric Lighting Supply and Fitting Company, Limited.—A final meeting of the shareholders in this company was held on the 21st ult., when an account was given as to the manner in which the winding up of the company has been conducted and its property disposed of.

Laing Electric Light and Power Company, Limited.—The registered office of this company is now situate at 13 and 14, King Street, Cheapside.

Latimer Clark, Muirhead & Co., Limited.—The last return filed by this company is made up to the 14th April, 1885, and was registered 7th May, 1885. The nominal capital is £100,000 in £10 shares. 4,702 shares have been taken up and are fully paid.

Shipping Appliance Company, Limited.—The registered office of this company is situate at 7, Fenchurch Street, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

The Railway and Electric Appliances Company, Limited.

THE third ordinary general meeting of the shareholders of this company was held at the Cannon Street Hotel, on Wednesday, under the presidency of the chairman, Colonel R. Raynsford Jackson. The following report was submitted to the meeting:—

Whilst in many respects there is a marked improvement upon the previous period, the result of the working is still unsatisfactory. The waggon cover fastener, the patent for which is held by the company, has contributed a considerable sum to revenue, all the transactions in this article having been of a profitable character. Fair progress has also been made with the jointless compensator for railway points, &c., introduced by Mr. Henry Williams, the manager of the company's works in Glasgow; and the reports received from the different railway companies which have adopted it are encouraging. The directors have secured the

working of several other patents for railway appliances, on royalties, and without having to make any preliminary cash payments, and it is anticipated that these arrangements will materially benefit the company. During the year various contracts for general railway work were secured, and in nearly every case the profit derived was fully as much as could have been anticipated at a time when trade is so universally depressed, and the competition is so excessive. It has not been possible, however, to secure sufficient work of a paying kind to cover all fixed charges, consequently there has been a loss of £848 16s. 4d. on manufacturing account. This is appreciably less than that incurred during 1884, and £8,182 0s. 2d. less than that of the previous period of about 18 months. The machinery and plant have been efficiently maintained out of revenue, but there being no net profit available for the purpose, provision has not been made for any further depreciation. The debit to profit and loss account for the year, including the loss of £848 16s. 4d. on manufacturing account, amounts to £3,753 15s. 2d., as against £4,601 0s. 11d. in 1884, which included £700 for depreciation of original stock. It will be noticed that the debit balance for 1885 includes the sum of £2,000 charged for directors' remuneration for the year, as fixed by the Articles of Association, but on reference to the balance sheet it will be seen that it has not been taken. Although the directors do not feel called upon at the moment to forego their right to claim the full amount, they do not, in the present circumstances of the company, contemplate appropriating more than £450 for their services during the last year. It will also be seen from the balance sheet that the amount to the credit of share capital "A" account has been materially reduced in pursuance of the compromise with the litigant shareholders referred to in the last report, and that a sum of £16,996 3s. 6d. stands to the credit of suspense account against the balance of £23,143 19s. 6d. to the debit of profit and loss account. The 50,050 fully paid-up shares which were to be surrendered under the compromise with the vending companies, have been transferred to trustees for the benefit of this company. In order to relieve the balance sheet of these shares, which are not now represented by available assets, it is expedient that they should, as soon as practicable, be cancelled; but as the Articles of Association do not at present authorise the directors to accept a surrender of shares, an additional article empowering them to do so will be proposed at the extraordinary general meeting, in the terms set forth in the notice convening the same. It has been the special aim of the directors to conduct the company's operations to a successful issue without having to make a further call, but various causes have prevented this, and, in their opinion, the interests of the company now require that more capital should be placed at their command; hence they have come to the conclusion that it is expedient to make a call of 2s. 6d. per share on the 51,701 shares upon which, up to the present time, 12s. 6d. per share has been called, and they trust the shareholders will concur in this measure. This would produce £6,462 12s. 6d., and, in order to cause as little inconvenience as possible, the directors propose to defer the date for payment until the 15th July next. Did the directors not fully believe that there is still a prospect of establishing a good business for the company, they would not have taken this step; and it must also be borne in mind that should the company be wound up, a heavy call would have to be made for the purpose of equalising the 12s. 6d. shares with the fully paid shares which have not been surrendered.

Mr. W. Shepherd, the secretary, having read the notice convening the meeting,

The Chairman said it was out of his power to report that there was any marked improvement in the affairs of the company. There had again been a loss at the Polmadie works, amounting, with the addition of the expenses in London, to £3,753 15s. 2d. This was a heavy loss considering the financial position of the company, but it was somewhat less than the loss in the previous year, when the amount was £4,888 16s. 7d.; this last mentioned loss, however, was swelled by £700 depreciation, and no depreciation had been taken off the stock this year. The loss in the works was £1,885 in 1884; in 1885 it was £845. He wished to point out, however, that although the loss appeared as £3,753, it was practically not so much, because an amount of £2,000 was credited to the directors for their fees. But, as the directors intended only to appropriate to themselves £450, the loss was practically reduced by the difference of £1,550; it was therefore £2,003. The directors would, however, reserve control over the remainder of their fees, in order that they might, if need be, meet contingencies like those which arose in 1884, when they pocketed no fees whatever; they did take a certain amount, but they spent that amount in meeting liabilities which would otherwise have fallen upon the company itself. The circumstances under which those payments were made had already been explained, and it was just possible that similar circumstances might arise so as to make it expedient for the directors to use in the interests of the company, and for the defence of their policy, part of the amount which still remained to their credit. He trusted the need would not arise, and he saw nothing looming before them which would lead him to think it possible that it would; but he thought it necessary to make this explanation. The circumstances which had told against the company during the last year were not, perhaps, peculiar in any way to this company. There was no doubt that the depression of trade, which had long been of such grave importance, still continued unabated, and, in addition to this, as far as regarded this company peculiarly, they had to face a disappointment. At the last meeting he informed them that the "Williams" cross-over had been successfully applied on one railway, and that they had received a second order for it. This second installation had given satisfaction to the railway company, and the directors felt encouraged to suppose that it was most likely that other orders would be given to the company for the cross-over. They had been disappointed in that anticipation; they had not received a single additional order for anything made under the patents of Mr. J. S. Williams. There could be no doubt that there was merit in his inventions; still, he was not at all surprised that the managers of the railway companies should act in a conservative sense in regard to that which affected their roadway. They might probably anticipate that one of these days they might come to hold a higher appreciation of the value of what he (the Chairman) believed was an important invention. The circumstances telling in favour of the company were that there was a continued demand for the waggon fastener, for which the company held the patent, and also an increased demand for the compensator, which the company also controlled; and the company had secured licenses for the use of some inventions upon payment of royalties, without in any way trenching upon its funds, and these arrangements they hoped would produce beneficial results. Another circumstance which was perhaps still more important, was that they had received a large order for general business from an important railway company, whilst smaller orders had also been received from other railway companies, so that there were indications that their business in that particular direction would develop hereafter somewhat more freely. He could not say that he was able to put before them a sanguine picture; but, at the same time, he thought they ought not to give up hope of seeing the company in a better position. He concluded by moving the adoption of the report and accounts.

Mr. F. G. Smith, a shareholder, seconded the motion.

Mr. Cumming asked as to the item of £3,898 for law expenses.

The Chairman stated that the company was engaged in a great number of law suits, and it had been the effort of the present directors to get rid of these suits and free the company from the embarassment, even ruin, which would have been the inevitable result had they not been got out of the way. The result of the arrangement made was that the company had to pay pretty heavily to the legal profession; nothing like so heavily, however, as would have been the case had the litigation continued.

Mr. Cumming further enquired what steps had been taken to recover the sum of £444, arrears of calls.

The Chairman said that arrear was principally due from one shareholder, who had held 900 fully paid up shares, which had been cancelled. They had a judgment against this shareholder, and it was a question whether they should take advantage of the Bankruptcy Act to force him to pay.

Mr. Cumming: Can you give me any idea of the turnover for the waggon fasteners?

Mr. Smith, a director, said something like 70,000 or 80,000 had been disposed of. The value of the fastener was not great, but the profit was very considerable.

Mr. Cumming suggested the sale of the Polmadie works, and the continuance of the manufacture elsewhere.

The Chairman said if they came to the resolution to sell the works and conduct only an agency business they might as well go a step further and wind up entirely. The directors, however, thought they might put the business in a better position by continuing the works. There were indications that they would soon be better employed. If those indications were not fulfilled, the directors would consider it their duty to consult the shareholders upon the condition of affairs before the time for the next meeting.

Mr. Smith, replying to a question as to the compensator, said they might form some idea of its value from the fact that in the specifications just issued by the North Eastern Railway Company for a contract, it was laid down as absolutely necessary that these compensators should be supplied, so that, even though this company did not get the contract for the general business, they would supply the compensators, of which, perhaps, 30 or 40 would be used. Wherever these compensators had been used—on the Caledonian, North Eastern, North British railways, and elsewhere—they had won universal approval.

The Chairman then read a letter from a shareholder, Mr. Arthur R. Jackson, who said he was prevented at the last moment from attending the meeting. He had at previous meetings supported the directors against the opposition they had met with, and did not wish now to become antagonistic to them. At the same time, after perusing the report, he thought the company was in such a desperate condition that he did not think they were justified in advising the proposed call. He had intended to move a resolution for the appointment of a committee of independent shareholders to investigate the position of the company prior to the passing of the report, and, as he could not attend, he desired that his letter should be read. Referring to this letter the Chairman said the directors had received a very large number of proxies, which, if they were used at all, would be used, he supposed, in support of the report. Then he might intimate that if the company were wound up the course that would have to be taken would be that the uncalled capital would be called up, and that and the assets of the company would have to be divided amongst the 12s. 6d. shareholders and the fully paid up shareholders. In that case the ordinary shareholders would not get back all the 7s. 6d. they would have to pay up.

Mr. Cumming: Would they get anything?

The Chairman: I hope so; but a great deal would go into the pockets of the paid up shareholders.

Mr. Cumming: Then it is a question of either paying the calls in the endeavour to resucitate the company, or paying them to the liquidator to be handed over to the paid up shareholders?

Mr. Smith said that was exactly the position. They must consider whether it was better to wind up and absolutely part with £5,000 or £6,000 to paid-up shareholders, or to strive, by submitting to a small call now, to bring the company into a paying condition. If they only covered expenses and kept the company going, making no further call, it would be better than appointing a liquidator, who, whether friendly or hostile to the directors, would immediately have to call up the 7s. 6d. unpaid.

The resolution was then put to the meeting and carried unanimously.

The retiring directors, Sir George Prescott and Mr. W. A. Smith, and the auditor, Mr. James Worley, having been re-appointed, the meeting was resolved into an extraordinary general meeting, when the following was added to the articles of association:—

"Art. 38A. The directors may accept from any member, on such terms and conditions as shall be agreed, a surrender of his shares or stock, or any part thereof."

A vote of thanks to the Chairman terminated the proceedings.

Indo-European Telegraph Company, Limited.

THE nineteenth ordinary general meeting of this company was held on Wednesday at the Cannon Street Hotel, Colonel James Holland, the chairman, presiding.

Mr. W. Andrews, the managing director, having read the notice convening the meeting,

The Chairman said that before submitting the report (which appeared in the REVIEW last week) to the meeting he would remark that it was a very satisfactory thing for the board to be able to submit a report so satisfactory in all its features. It showed an increase of upwards of £18,000 over that of the preceding year, which itself was not a really bad one. The balance sheet called for little remark, but there was one item worthy of notice, viz., the small amount of law charges (£40) for the year. That was very satisfactory to them, but hardly so to their excellent solicitor, Mr. Bristowe, who so well conducted the business of the company. That gentleman had for some years been their legal representative, and on all occasions whatever he had done had been most satisfactory. While they had made upwards of £18,000 in excess of the preceding year, the expenditure was somewhat less than that of the preceding year. There was an crease of £1,600 to enable them to work the much greater traffic they had had, but that had been more than compensated by the improvement in the accounts for maintenance. That charge had for some time past been improving, and much had been done to keep the line up to the highest standard of efficiency, so that it was next to impossible for anything to be better. But, in spite of that, the cost of maintenance was £1,700 odd less than in the preceding year. If anything could add to their deep debt of gratitude to the managing director, Mr. W. Andrews, he thought that fact alone would go to their hearts, which in the case of shareholders were said to reside in their breeches pockets. One of the causes (after awarding all praise to Mr. Andrews) of the present satisfactory state of things was that they had always taken care from the beginning to have no increase of their capital charges. Whatever expenditure had been incurred had been taken from revenue. Day by day expenses were paid up, and they had nothing lurking behind to give them the slightest apprehension. Their costs were paid as incurred, and the capital was in no way watered. They hoped to be able to carry on that system, and then he saw no reason why the same satisfactory progress might not be relied on year after year. From the line being in so efficient a state they might naturally infer that the company might go on realising the large profit of last year. But he must certainly put a damper on any extravagant hopes of that kind, because, as was stated in the report, the large augmentation of revenue is quite exceptional, and is owing to the total interruption of the Eastern Company's lines for some three weeks, the disturbances in Burmah, and the Afghan frontier question, and it is satisfactory that the £18,046 11s. 4d. of additional revenue has only occasioned an increased expenditure on commercial account of 1,637 7s. 7d. They must not, therefore, expect that kind of revenue every year. Wars and political disturbances had during last year proved exceptionally beneficial to them. But they were like a two-edged sword, and cut both ways. They had had sad experience of the injury war could do them in the war between Russia and Turkey, when some 60 miles of their line was destroyed and their capacity for earning revenue stopped for some time. So that, although war might sometimes prove beneficial, as during last year, from the large amount of political intelligence that passed over their line, it might be just as damaging. Their truest friend was commercial prosperity, which unfortunately had been at a low ebb. All they could do was to hope that things might mend, and that commercial prosperity might last. That it might be of advantage to them it was necessary to do their utmost to satisfy the commercial public. They could do that by working the line, as they were doing, in the most efficient manner. He had said to whom that was mainly due. Merchants were satisfied with the way the work was done; but they might say that heavy prices were charged for that good work. The company, therefore, in view of the profit they had made for some years, and in the hope that trade would improve, had, at the last quinquennial conference of the different telegraphic authorities of Europe, proposed to reduce the rate of 4s. 7d. a word for India to 4s. The Indian Government was anxious to see such a reduction as might be fairly made, and therefore that tariff would come into operation from the 1st July next. Considerable reductions had also been made in the trans-Indian charges to China, Malacca, and other places beyond India, varying from 1s. to 1s. 6d. per word. The reduction was an argument why they must not expect an overwhelming profit year by year; for every reduction told upon the gross profit, whereas dividends were paid out of net profits. In addition to the reduction referred to, they were now consulting with the Post Office and with other companies in regard to a considerable reduction in the Press rate, a measure originally proposed by their company, and carried out in the first instance by the East India authorities, who were partners with them in this concern. That was a satisfactory partnership, because the influence of the powerful Indian Government shielded them to a great extent from unreasonable competition, on the one condition that their line worked in the most perfect manner that was possible. If they failed in that respect they would be liable at once to find competitors in the field. There would be no lack of exertion on their part to prevent that occurring, by utilising every discovery of science. Their line was only valuable as a going concern, and any political convulsion which destroyed it would render it valueless—a very strong argument for greatly increasing their reserve. Of course, though they had reduced their tariff, they were in hope that the usual increase which usually followed reduction might tend to recoup them. The Chairman then formally moved the adoption of the report and accounts.

Mr. Weaver seconded, and the motion was carried unanimously, as was also a resolution declaring a dividend of 17s. 6d. per share, making, with the interim dividend, 6 per cent. for the year, and a bonus of 30s. per share, free of income tax, making in all 12 per cent.

The Chairman and Mr. H. H. Meier were re-elected directors; C. F. Kemp, Ford & Co. were re-elected auditors; and the proceedings closed with a vote of thanks to the chairman and board.

Reuter's Telegram Company, Limited.

THE twenty-second ordinary general meeting of this company was held on the 22nd inst. at the offices, Old Jewry, under the presidency of Colonel James Holland.

The Secretary having read the notice convening the meeting, and the report, published in the REVIEW last week, having been taken as read,

The Chairman, in moving the adoption of the report, expressed the great regret of the directors at the fact that, for the first time in the annals of the company, they were unable to pay a dividend. Having quoted from his remarks at the last meeting, when he prepared them for this contingency, he stated that it had not been in their power until a very late period to moderate in any way their agreements with the Press, as they were for fixed dates. After those dates had expired they made representations to the Press, who had agreed, in future cases of wars or great disturbances such as to necessitate a considerable addition to the expenditure of the company, that they would increase the amount of their remuneration to an extent which would practically prevent any recurrence of the company's present position of not being able to pay a dividend. They had a hope at the last meeting that warlike operations had ceased or were about to cease, and that, therefore, notwithstanding the heavy expenditure they had incurred without return, they might have a moderate profit at the end of the year; but since then, from Khartoum to Burmah had been one unceasing round of wars of one kind and another. The Rangoon affair, although a satisfactory matter as regarded the interests of the country, had been, as all wars were for the company, unfortunate, as it had caused them to incur considerable expenditure. They had also suffered from the depression of trade and the depreciation in silver, their remittances from India having been very considerably "watered." Referring to the balance sheet, he stated that the various items under the heads of sundry debtors and sundry creditors had all run off. As regarded the future they would, in the event of the contingencies mentioned arising, receive increased payments from the Press; and although they had not yet made up their receipts account for the first quarter of this year, they knew that the expenditure on telegrams in that period had been over £2,000 less, compared with the corresponding period of last year. They also had no bad debts. He concluded by referring, with regret, to the absence of Baron de Reuter (whose health compelled him to reside abroad for some time), and to the death of Mr. J. S. Stopford, one of the original directors of the company.

Admiral the Right Hon. Sir J. C. D. Hay seconded the motion, which was carried unanimously, and the retiring director and auditors were re-elected.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 23rd were £1,998, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ending April 23rd amounted to £2,487.

NEW PATENTS—1886.

4553. "Deposition of platinum by electricity." W. A. THOMS. Dated April 1.

5479. "Gauging electric currents: apparatus for that purpose." S. C. C. CURRIE. Dated April 20.

5531. "Pole pieces of dynamo-electric machines." W. T. GOOLDEN, A. P. TROTTER, H. W. RAVENSHAW. Dated April 21.

5532. "Electric furnaces for the manufacture of chemicals and utilising substances obtainable thereby." W. P. THOMPSON. (Communicated by Cowles Electric Smelting and Aluminium Company.) Dated April 21.

5542. "Regeneration or production of chromic acid from exhausted battery and other solutions." D. G. FITZGERALD. Dated April 21.

5564. "Pneumatic despatch tubes." J. G. WALKER, J. NEWTON. Dated April 22.

5565. "Automatically controlling the inrush of air into pneumatic despatch tubes." J. G. WALKER, J. NEWTON. Dated April 22.

5588. "Dynamo-electric machines." W. M. MORDEY. Dated April 22.

5606, "Electric switch." W. H. PREECE, J. W. WILLMOT. Dated April 22.

5611. "Generating electric currents." H. H. LAKE. (Communicated by Helios Electric Light and Telegraph Construction Company.) Dated April 22. (*Complete.*)

5664. "Electric motors and transmission of power therefrom." M. H. SMITH. Dated April 24.

5677. "Electro-galvanic brush for the hair, &c." T. W. LAWSON. Dated April 27.

5700. "Raising and lowering telegraph or other cables." A JAMIESON. Dated April 27. (*Complete.*)

5725. "Electric arc lamps." E. G. BREWER. (Communicated by D. B. Macdonald and H. W. Woodman.) Dated April 27.

5731. "Galvanic batteries." A. DUN, F. HASSLACHER. Dated April 27.

5745. "Insulating compound for electric conductors or cables." H. H. LAKE. (Communicated by W. P., H. B. and J. Tatham, and D. Brooks.) Dated April 27. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

16437. "Improvements in the preparation and application of materials, fabrics and structures suitable for the construction of electric apparatus, cells, chambers, or dielectrics, and for other purposes." J. S. WILLIAMS. Dated December 13. 6d. In carrying this invention into practice in its application for dielectrics or separating plates or partitions between the electrodes or elements of accumulators or batteries, the inventor takes sheets or plates of iron or other metal, suitably perforated or rendered porous or honeycombed, or metallic gauze or asbestos fabrics or paper similarly perforated, or strands, wire, or ribbons of such material built up so as to form sheets or fabrics, and subject such material to a process of enamelling by which the surfaces of such material are coated or covered by a protecting coating of vitreous enamel or glaze. He fills up the interstices, or spaces or openings, or perforations, with a chemically and electrically neutral porous material, such as with powdered asbestos or pumice stone, or kaolin or ganister, or compound soluble silicates, or a combination of such or equivalent material, which may be mixed with a suitable cementing agent, such as Roman or Portland cement, or equivalent substances.

16438. "Improvements in electric accumulators or batteries, their construction and operation, and in apparatus or means employed therefor or therewith." J. S. WILLIAMS. Dated December 13. 6d. Relates to batteries or accumulators adapted to be charged or revivified or maintained in a working condition through the action of an electric current, or by the actions of gases or media for restoring or maintaining the elements in a working condition, they being provided with electrical connections led off from the co-operating electrodes of opposite signs from the tops of those of one sign and the bottoms of those of the other sign, and from the corners or parts thereof diagonally opposite. Also in combination with this improvement the inventor employs electrodes or elements provided with electrical connections or electrical channels at the ends or edges thereof, having an electrical conductivity approximately equal to or greater than the conducting or transformable capacity of the electrodes or series of leaves thereof. Also in combination with one or both of these improvements, or either of them, he employs compound interlacing electrodes or folded electrodes.

1885.

3446. "Improvements in and relating to electrical generators and motors." T. J. HANDFORD. (Communicated from abroad by F. J. Sprague, of New York.) Dated March 17. 1s. 1d. The object of this invention is to so construct an electro-dynamic motor or dynamo-electric generator that it will be self-regulating, so that the motor may be made to run at a constant speed under varying loads, in a circuit either of constant current or constant potential; or the generator may develop a constant current or a constant electromotive force. The motor used is a differential motor—that is, one having two sets of field coils, one in series with the armature, which is termed the "governing coil," and the other in shunt relation to the armature. The latter coil is of higher resistance and greater number of turns than the former; it is the principal coil and determines the polarity of the field. The inventor has found that a certain proportion must exist between the main coil and the governing coil to give the best results either with constant current or constant potential, and it is in this that the invention chiefly consists.

4141. "Improvements in the appliances for, and mode of, connecting, clamping, and holding the cables, wires, and conductors used in the transmission of electric currents." O. MARCH. Dated April 1. In a block *c*, figs. 1 and 2, of brass or other suitable material, and preferably of an approximately cylindrical form (with or without flanges, f^1, at the base for attachment) is cut a vertical slot of suitable width from the top downwards to within about $\frac{1}{4}$ of an inch from the bottom. A hole, *e*, is drilled transversely through the block, *c*, aforesaid, and at a distance of about $\frac{1}{2}$ an inch from the bottom of the latter; said hole, *e*, being drilled or formed in such a way that its axis passes through the block, *c*, at right angles to the plane of said slot. In the slot aforesaid is placed a metal slide, *d*, of a thickness suitable to allow of its being readily slid up and down in the slot. The metal slide, *d*, is formed at the top with, or has attached to it, a screw which passes, as shown, through a suitable nut, *a*, resting

FIG. 1.

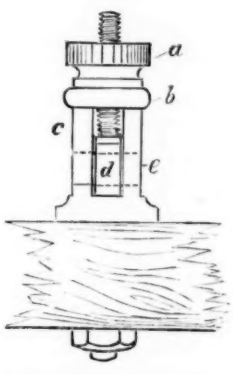
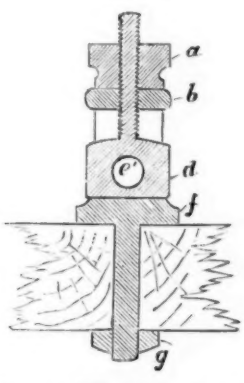
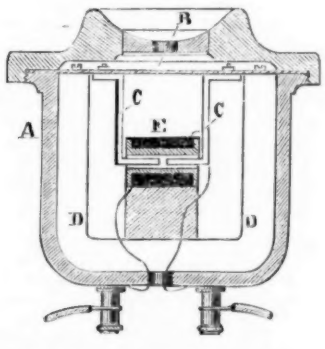


FIG. 2.



on the top of the slotted block. A hole, e^1, is drilled through the metal slide, *d*, and of a diameter corresponding with that of *e*, the hole formed through the block, *c*, in such a manner as to ensure that when the slide, *d*, is at the bottom of the slot, the corresponding hole, e^1, in the slide is opposite the hole, *e*, drilled in the block, *c*. The cable or conductor is passed through the holes, *e*, e^1; and, on the nut being screwed down, the slide is raised, and thus the cable or conductor becomes clamped between the bottom of the hole in the slide and the top of that in the block. By the means above described cables or conductors (of any size that can be passed through the holes, *e*, e^1), can be securely clamped; and, in the case of stranded wires or cables, without displacing the strands, as also in such a manner as to secure efficient electrical contact. By a modification of the arrangement, a wire can be secured at any intermediate point in its length; for this purpose the portion *d* is made of a hook form.

4423. "Improvements in electro-telephonic instruments." S. P. THOMPSON. Dated April 9. 8d. The object of the invention is to construct telephonic instruments very cheaply and of



great power and efficiency, especially when used as receivers, although they may be used as transmitters if desired. A is the

box or case of the instrument in which is held the elastic or stiff body or spring, B, which may be of mica, ebonite, wood, brass, or other non-magnetic and elastic material. At or towards the sides or edges of this spring piece, B, pieces, C, are attached, the said pieces forming part of a magnetic circuit by reason of their being in proximity to the magnetised bar, D, the said pieces, C, being preferably attached to the spring, B, so that they can move independently of the main body of the magnet, D, to which also the spring, B, may be attached, as shown. Around, but preferably not touching the approximated ends of the pieces, C, is fixed the coil, E, in connection with the external wires.

5808. "An improvement in cable grapnels." H. C. MANCE. Dated May 12. 6d. The inventor attaches to an ordinary cable grapnel certain bars which act as fenders, keeping the prongs clear of rocks, but in no way preventing the cable being hooked when the latter is clear of the ground. The grapnel is balanced so that it travels over the ground with the prongs clear of the bottom instead of searching in the mud, sufficient spread is given to the fenders to cause the prongs to remain clear of rocks, and there is sufficient clearance between the end of the fenders and the points of the prongs to allow of a cable being hooked the moment the fenders are clear of it.

5828. "Improvements in the mode of vulcanising the insulating covering of electrical conductors." B. J. B. MILLS. (Communicated from abroad by J. J. C. Smith, of America.) Dated May 12. 6d. A sheet of the insulating compound is laid firmly on a long sheet of heavy tin foil, and then both are cut in long narrow strips. Such strips of tin foil, in combination with the vulcanisable insulating material, are laid on the wire by means of the covering machine. When the insulating cover is to be vulcanised the covered wire is coiled on a large but light metallic reel in two or three layers. This reel is so arranged that it may be put readily in and out of the vulcaniser, and that it can be revolved horizontally in the vulcaniser while the same is closed and in operation. When the vulcanisation is completed the wire is taken out, and the tin foil envelope having performed its function, is removed from the insulating covering, leaving a smooth and dense surface.

6286. "A novel telescopic swinging and rotating pendant and switch for one or more incandescent electric lamps." A. GRUNDY and G. W. READY. Dated May 22. 8d. Relates to the arrangement described in the No. of the REVIEW for August 1st, 1885.

7461. "Improvements in galvanic batteries." A. R. UPWARD and C. W. PRIDHAM. Dated June 18. 8d. Relates to gas batteries constructed in the following manner:—Each battery cell consists of an outer and an inner vessel, the latter is porous, and both vessels may be of earthenware. On either side of the porous vessel the inventors introduce into the outer vessel a carbon or negative element, and the void space around it and between the two vessels they fill with broken and moistened carbon. They introduce into the space on one side a pipe preferably of glass passing down nearly to the bottom, and on the other side a pipe dipping down a short distance only. They then apply pitch, or other like cementing material, to seal in the space between the two vessels at the top, but leaving the inner porous vessel open at the top When the battery is at work chlorine gas is admitted to the space to circulate amongst the broken carbon, entering by one pipe and passing on by the other. The porous vessel receives the positive element within it; this element is usually zinc, but iron may be employed. The positive element is simply immersed in water or liquid which the porous vessel contains.

8036. "Improvements in electric telegraphs." H. C. MANCE. Dated July 2. 8d. The object of the invention is to improve the apparatus for translation of telegraphic signals automatically between two circuits (cables or land line) when relays of an extremely sensitive or unstable character are employed, although designed more especially to meet the requirements of the Brown-Allan relay, the improvements can be worked in connection with other relays and telegraph apparatus. The general arrangement of the connections for automatic translation would be substantially similar to that of other systems of double current translation. The improvements consist of a clockwork with suitable mechanism and contacts contrived and arranged, to obviate the difficulty caused by the uncertain character of very sensitive relays, which sometimes come to rest with the local current open and sometimes with it closed.

14288. "Improvements in dynamo-electric machines." J. A. BERLY. (Communicated from abroad by Z. T. Gramme, of Paris.) Dated November 21. 6d. The object of the present invention is the construction of dynamo-electric machine frames in one single hollow piece, the said piece constituting at one and the same time the bed plate, the cores of the electros, the polar pieces, and one of the bearings of the machine. The complete frame of the dynamo-electric machine is obtained by the addition of a second bearing.

15276. "Improvements in telephonic and other call apparatus." E. F. FROST. Dated December 12. 8d. Relates to certain improvements in individual telephone signals of that class in which step by step devices are actuated by a current of given direction to circuit the bell, which is then actuated by impulses of reverse direction; and it consists in a novel combination of a transmitting apparatus with the signalling devices in such manner that any office may signal another on the same circuit without the aid of the exchange by means of a slight modification of the usual magneto-generating machine; also in an improved form of magneto-generator for operating the signals; also in a novel arrangement of the connections through the transmitting and magneto-generating devices.

15344. "Improvement in electric registers and recorders intended for registering, recording, and checking fares, sales, receipts, entrances and exits, change of conductors or other persons operating said registers and recorders, and for similar purposes." E. A. SCALES. Dated December 14. 8d. Relates to electric alarm registers and recorders, and consists in the circuit closer for operating such a register; means of preventing the register from recording more than one fare at a single closing of the circuit; means of causing the apparatus to register before sounding the alarm; means of producing a permanent record of the number of times the circuit is closed and means of recording a change of conductors.

15455. "Improvements in electromotors and dynamo-electric machines." J. C. MEWBURN. (Communicated from abroad by W. Main, of America.) Dated December 16. 8d. In these improved machines there is no reversal of current in the exciting coils, and consequently no current is consumed in forcing a reversal of polarity to overcome residual magnetism and effect a repulsion of the mutually receding masses of iron.

15617. "Improvements in electrical switches." H. B. BOURNE and H. R. F. BOURNE. Dated December 19. 6d. The object of the invention is to insure that the making or breaking of the contact in an electrical switch shall be independent of the control of the operator.

CORRESPONDENCE.

Suggestions as to Testing the Merits and Life of High and Low Resistance Incandescent Lamps.

The question as to the merits of the various systems of lamps now sold being a very important subject, both to the manufacturer and consumer, especially the latter, as there appears to be no reliable data at present which can be relied upon to guide the purchaser in selecting his lamps, perhaps you will permit me to intrude on your valuable space with a few remarks that may tend to bring about a discussion relative to the several points hereinafter mentioned, and thus lead to the desired information being obtained and recorded in the scientific journals for the benefit of those engaged in the development and success of electric lighting, the carrying out of which differs materially in many special cases in consequence of numerous difficulties to be contended with in connection with the incandescent branch of lighting by glow lamps, consequently no "rule of thumb" system can be relied upon to fill all the necessary requirements.

It is only natural that all inventors should consider their own lamps the best, and in some cases for many purposes perhaps it would be so; but circumstances alter cases, and when one type of lamp would be just the thing to suit some particular machinery being used, in another it may be worthless, and not at all suited; hence many failures occur, to prevent which much careful judgment and experience is needed, as upon the lamp greatly depends the success of an installation. It is for this reason that I venture to offer some few remarks and suggestions upon the above, which just now in electrical circles is the leading topic of the day, especially as opinions differ so widely upon this subject. Some engineers will recommend nothing but high resistance lamps, and if you ask them to give you a practical reason, they are unable to give an answer, beyond: "I must have them, because my dynamo is wound for such and such a potential;" whereas others are believers in very low resistance lamps, but attempt extremes. Now it stands to reason one or the other must be wrong, and I prefer to form my own opinion, and would state that I am a believer in the happy medium, and consider a lamp of 30 volts to be the most useful and practical voltage for general purposes, and without doubt the very best and most suitable for domestic lighting; and I am convinced that there is nothing so economical and safe for small installations as a 16 candle-power lamp of low resistance, taking a pressure flow to make it glow of not

more than 30 volts E.M.F., and absorbing, say, 0·9 ampère of current to fully incandesce it.

My firm has during the past season carried out numerous temporary installations for balls, bazaars, &c., and has installed several 30-light permanent installations, and in each case using our 30 volt standard low resistance lamps, which are working admirably for the purpose. I am therefore able to speak with some authority from practical experience ; and I am certain for small electric light installations of this kind, both for economy in working and outlay of capital, there is nothing to beat a 30 volt lamp being used for this purpose, and to very great advantage in more ways than one ; the most important of which is, that there is a difference of 20 per cent. in favour of the 30 volt over the 50 volt being used.

I would also point out that engineers can produce a far better dynamo for the money to run the former, and 10 less accumulators are required ; besides, a smaller gas engine or domestic motor will suffice to do the work ; less space is also required, and last, but not least, even when machinery is entirely dispensed with for generating the current, and one has to resort to the expensive method of charging accumulators for domestic lighting from a primary placed in the garden for this purpose, the saving is very considerable in zinc and acid consumed. Moreover, if a 60 volt dynamo is used in larger installations, better results are obtained even then by running two 30 volt 14 C.P. lamps in series, instead of one 60 volt 20 C.P. lamp in multiple, which in the former case can be used with safety by having a spare shunt lamp, in case of breakage, thus obtaining 8 per cent. more light by this means, which to the consumer is an important item in a small installation.

Having opened up a field for argument, it rests with others to follow suit ; and I would suggest, in order to obtain authentic information, and to ascertain the best all round lamp in the market, that special and reliable information should be obtained and recorded as to "*The Merits and Life of both High and Low resistance Lamps*," and the following points be practically enquired into, and the facts recorded for the benefit of the uniniated who are desirous of knowing :—

1.	The life of lamps when fed entirely from			Storage batteries.
2.	Do.	do.	do.	Primary ,,
3.	Do.	do.	do.	Thermopiles.
4.	Do.	do.	do.	Secondary generators.
5.	Do.	do.	do.	Shunt wound dynamos.
6.	Do.	do.	do.	Compound dynamos.
7.	Do.	do.	do.	Dynamo wound for low E.M.F. with increased out-put in ampères.
8.	Do.	do.	do.	Dynamo wound for just the opposite theory.
9.	Do.	do.	do.	The above tests carried on circuits, say, of 100, 200, 500, 1,000 and 2,000 yards' distance from dynamos, and results recorded.
10.	Do.	do.	do.	The exact C.P. obtained from the lamps at each of above distances.
11.	Do.	do.	do.	The use of high-speed engines.
12.	Do.	do.	do.	Low-speed engines.
13.	Do.	do.	do.	Gas engines.
14.	Do.	do.	do.	Turbines.
15.	The life of lamps and results by running lamps 2 and 3 in series of equal voltages over lamps in parallel.			

There are many other points I could mention, but the above will suffice for general requirements, as in each case different results will be obtained upon experiment. Under these circumstances, it is important in the interests of electrical science, if possible to find out the reasons, in order to enable engineers to carry out electric light installations with satisfaction and economy combined, for upon these two points depends the future of success of incandescent electric lighting.

Arthur Shippey.

13 and 14, King Street, Cheapside, E.C.,
April 27th, 1886.

New Experiments on Electricity, Heat, and Light.

In my letter to you of the 3rd inst. I produced experimental proof that electricity is a component part of the substance which we call ozone, and I broached the opinion that the flash of light seen by MM. Hautefeuille and Chappius in the glass tube must have been the result of the union of a portion of the extra heat with the electricity which had formed a component part of the ozone prior to the ozone's decomposition, which caused the explosion. To determine the connection between, or rather, the relative positions of electricity and heat, I made the following experiments :—I have a Geissler vacuum tube of the shape of the letter V, each leg of which measures 7½ inches in length, and the outside diameter of it is ¾ of an inch. The platinum terminals being at the upper ends of the letter V. I adjusted this tube so that a powerful current of electricity passed through it from a Ruhmkorff's coil. I noted the amount of light produced within the tube while it was thus in the atmosphere of the room, at a temperature of + 67° Fahr. I then had it placed in a freezing mixture of ice and salt at a temperature of + 5° Fahr. In this position, the light within the tube was greatly diminished. I then had the same tube, with the same arrangement of coil, immersed in boiling water. Immediately, a wonderful effect was produced. There was a greatly increased amount of light within the tube ; a brilliant bluish flame filled both legs of the tube, and also striæ appeared of a very marked kind. As the latter never appeared in the tube when it was not in the boiling water, this leads to the conclusion that the striæ are produced by increments of heat passing through the glass into the interior of the tube.

These experiments establish that the light produced in the tube which MM. Hautefeuille and Chappius saw must have been the result of the union of the heat and electricity within the tube ; and further, these experiments lead to the conclusion that if we could place the V Giessler tube, or an incandescent electric lamp, in an atmosphere void of heat no light would be seen in them, although a powerful current of electricity were passed through them.

James Johnstone.

8, Merchiston Park, Edinburgh,
April 27th, 1886.

Prof. Hughes on Self-Induction.

I have noticed several criticisms upon my paper upon self-induction, most of which have appeared in your valuable journal, and I believe they all require a few remarks in reply.

The criticisms may be divided into three classes :—

1st. Prof. H. F. Weber shows that the method which I employed admits of numerous errors, and consequently infers that the results which I have announced are due to an "incorrect interpretation."

2. Mr. Oliver Heaviside points out that upon a close examination it will be found that all the effects which I have described are well known to mathematicians, and consequently old.

3. Mr. Willoughby Smith points out that the results which I have announced are contrary to theory and practice, and experimentally demonstrates that he is unable to obtain any difference even between iron and copper.

I must say that I am unable to agree with these opposing views, for if we assume with Mr. Heaviside that all my results are contained in some mathematical formula of which I am unaware, then the mathematicians ought to feel extremely grateful for the experimental proof with which I have furnished them; if, on the other hand, we agree with Mr. Willoughby Smith, then

the formula and my results should at once be abandoned as experimentally untrue.

Prof. Weber's objection is more serious, and I fully admit that it is possible to make very serious errors if the sonometer is not calibrated, or if we do not appreciate the errors that can be easily introduced. I feel sure that Prof. Weber could have seen how such errors could have been avoided, and this even by several means that I have indicated, such as making comparative tests between wires of the same length and resistance so that no change took place in the bridge adjustment except that due to the differential results.

The only question which I consider important is, Are the effects which I announced true physical effects due to the nature or form of the conductor, or are they simply due to some peculiarity of the method which I employed? To answer this I have constructed an instrument based upon an entirely different method, one of extreme simplicity, and one which does not allow of any possible error.

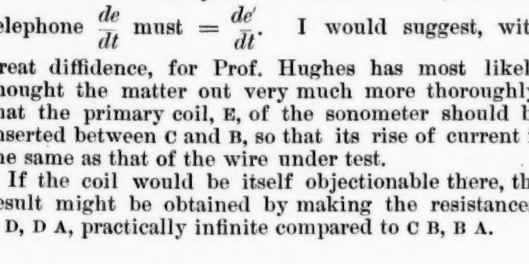
I propose to publish a description of this instrument (together with the results obtained) during the coming month, when I hope that its demonstrations will prove clearly all that I have said as to the influence of the form as well as the nature of the conductor upon its self-induction.

D. E. Hughes.

There are one or two points in Prof. Hughes's address which seem to have been little dwelt upon in the discussion.

In the use of a telephone instead of a galvanometer in such a null method the telephone will not necessarily be silent even when the galvanometer shows no deflection. For a galvanometer to show no deflection it is only necessary that $f\,t\,d\,e = f\,t\,d\,e'$ where e is the counter E of induction in the wire under test and e' the E of the secondary coil of the sonometer, but for a telephone $\frac{de}{dt}$ must $= \frac{de'}{dt}$. I would suggest, with great diffidence, for Prof. Hughes has most likely thought the matter out very much more thoroughly, that the primary coil, E, of the sonometer should be inserted between C and B, so that its rise of current is the same as that of the wire under test.

If the coil would be itself objectionable there, the result might be obtained by making the resistances, C D, D A, practically infinite compared to C B, B A.



Another method would seem to be replacing C D by a duplicate of the wire under test; if C B and D A have no self induction this would seem to give the conditions of silence. As the current in x is then always half of that in E, their rate of increase at any instant is the same.

Though it has been mentioned since, none of the speakers noticed that the induction of the sonometer is only proportional to the angle when that angle is infinitely small; might it not be calibrated by using different lengths of a wire in A B, or A B and C D?

There seems to be something anomalous in the behaviour of glow lamps with alternating currents. Thinking that the resistance of carbon might depend on the current density, I had some experiments tried to see, but the results were conflicting. In July, 1884, Mr. Ram carried out several for me. If the resistance of carbon remains practically constant through a good range of temperature, as it appears to do with a direct current and a reasonable brightness, one would expect that a lamp which gives a certain light with a direct current and a certain current dynamometer reading, would give the same light with a smaller reading with an alternating current, for the light of a lamp is not as the power. One would further expect that the thinner the carbon, or the slower the alternations, the greater the discrepancy would be. Instead of this, Mr. Ram found that, of several lamps running at the efficiency of $\cdot\dot{3}\ c\ p\ w$ on a direct current, the mean square reading with an alternating current, was from 7 to 13 per cent. more. This would seem to show that the resistance falls with a large current density; but further experiments by other methods did not confirm this view at all. By resistance I mean not opposing electromotive force due to rising current, but resistance.

Profs. Ayrton and Perry make slips so seldom that they will be glad if I point out that they could not expect a lamp to give the same readings with alternations of different period; as for such a result the carbon must either have no mass or no specific heat. A lamp will, of course, burn brighter with the same mean square current reading and slow alternations; and it is not necessary to assume enormous self-induction in the dynamometers to account for this. Local currents, of course, do not affect the reading of the dynamometer. If carbon behaves anomalously under alternating currents, it is possible that it interfered with the accuracy of M. Joubert's researches in dynamos.

Surely there is no need to call counter electromotive force resistance even when it is due to self-induction and causes Prof. Forbes's local eddies. For instance, Profs. Ayrton and Perry have gone to considerable trouble to show that these local currents produce resistance. Would it not be far simpler to say that if you have a current through a lot of conductors in parallel, and you put counter E into some or all of them, more external E is needed to keep the total current constant?

Jas. Swinburne.

The recent revelations made by Prof. Hughes on the above subject have undoubtedly taken the scientific world by surprise, apparently, the more so, inasmuch as both physicists and electricians are making of it the scientific theme of the day.

Such disclosures, made by such an authority on the subject as Prof. Hughes, have a great weight in the scientific scale, consequently it is not surprising, but only natural, that they should excite keen comment and criticism, considering that if time and further researches should prove them to be correct it would necessitate, if not a radical reform, at least a thorough amendment, of some of the universally accepted laws on electro-dynamics.

Meanwhile Prof. Hughes can afford to listen calmly to the scientific debate, and await with comfort for the final verdict, knowing, as everybody does, that truths, like facts, may be temporarily eclipsed, submerged, and defeated, but at the end they ultimately rise as victors.

It may not be inopportune or uninteresting to quote here the substance of Prof. Hughes's abstract paper, read as his inaugural address on the 28th of January, before the Society of Telegraph-Engineers, on the occasion of his election as president of the said society. After describing the ingenious apparatus which served for his researches on self-induction (which consist of a Wheatstone bridge, intersected in the diagonals by the two concentric coils of a sonometer, connecting in one a battery and an automatic make-and-break, and in the other a telephone in place of the galvanometer, as in the ordinary bridge), he proceeded to describe his experiments, drawing contemporaneously from them the following conclusions and statements in

regard to the inductive capacity of metallic conductors traversed by intermittent currents. He said :—

"In a metallic straight conductor the force and duration of the extra currents varies :—

"1. With the kind of metal with which it is made.

"2. With its molecular condition or physical state.

"3. With its sectional area and form, independent of its resistance or the electromotive force of the primary current.

"4. The time of charge and discharge of the wire is independent of the electromotive force of the extra currents ; but increases rapidly with the section.

"5. With a constant length the electromotive force of the extra currents increases with the section (but not in an equal ratio except in soft iron) up to a limited maximum point, from whence it varies indirectly with the section, this maximum point varying with different metals.

"6. (Probably) with non-magnetic metals, the greater the specific resistance of the metal, the higher the maximum point (relatively to its diameter) before the reversal takes place.

"7. The form of a conductor has more influence on its self-induction than its resistance or even the nature of its metal.

"8. In a metallic straight conductor, the electrical resistance is greater during the 'variable' than the 'stable' period of the current.

"9. With fine wires and powerful currents the effect is reversed, *i.e.*, the electrical resistance is greater in the stable than in the variable period.

"10. The reaction of two parallel return wires varies more with the nature of the metal than upon the proximity of the wires.

"11. Some metals whose self-induction is high in a straight-formed conductor, when formed into coils becomes low ; whereas the reverse happens with those whose self-induction is low in a straight-formed conductor.

"12. In parallel return wires, the force of extra currents is less than in straight wires.

"13. In short wires the duration of extra currents is exceedingly small.

"14. The self-induction of a conductor is greatly diminished by subdividing the same in several small conductors or streamlets.

"15. For a single conductor, the worst possible form is the circular section ; the best being the ribbon form, thin and wide.

"16. Currents in copper wires are far more influenced by an external wire than those in iron.

"17. In a solid bi-metal conductor the self-induction is less than in a mono-metal conductor having the same stable resistance and sectional form ; this being due to the difference of electromotive force of the extra currents in the two metals, each mutually reacting as shunts upon one another."

It would be rash to accept all these statements as future laws in electro-dynamics simply on the authority of one man (no matter how great that authority might be) without at least repeating the same experiments by different methods, and by a plurality of observers, in order to effect a reliable check of the results of each experiment and method. Anyone who has had anything to do in these sort of experiments knows very well that if accurate testing is to be the aim, nothing but independent tests, made under a multiplicity of conditions, can lead to the true value ; for, as it has been proved before, in so complex a field as that of electro-magnetic induction, where one effect easily reacts and influences the other, and *vice versâ*, the possibility of errors is ever there, and may often baffle the closest attention of the keenest observer. One need only compare the different results obtained by independent experimenters on the determination of the electrical standard of resistance in absolute units, and compare them also with the results obtained by the committee appointed by the British Association for the Advancement of Science in 1862, for to convince himself how far true the above remarks are.

When laws of nature are in question, it is rash and futile to attempt to confute the results of a series of experiments by the simple substitution of a few mathematical expressions, such as has been done by Prof. Weber, of Zurich, in *La Lumière Electrique* and the ELECTRICAL REVIEW.

For example, let us try to examine some of the most startling points in Prof. Hughes's paper, and see how far they differ from known laws. Taking 1 and 2, we see them at once to be in contradiction with accepted laws, although I may say, from my own experience, I have often been led to believe, in at least between copper and German silver wire, there was some difference in their self-inductive capacity ; but in what degree I have never been able to ascertain. The following description, I trust, will not be inopportune, inasmuch as it serves to illustrate the point.

Some few years back I happened to make some copper standards of resistance, reproducing them from one B.A.U. in platinum-silver.

My bridge consisted of two German silver arms, with an intermediate balancing wire of the same alloy. On the opposite side it formed the quadrilateral by the unknown copper coil and the platinum-silver standard ; all the coils being neutrally wound. A battery, a double key, and a reflecting galvanometer completed the diagonal circuits. After a few preliminary adjustments with the first copper coil, I soon came to a point where I encountered some difficulties in ascertaining the true temperature of it, in consequence of the prolonged time that elapsed between putting the battery in circuit and the time required for the bridge to return to stability before the galvanometer could be put in circuit, or unshunted as the case might be. To reduce the heating of the wire as much as possible I resolved to reduce the strength of the battery, making up for this by an increase of sensibility in the galvanometer.

With this view I constructed a special needle with the least possible inertia, whilst retaining as much as possible its magnetic moment. Although I found this to be a step in the right direction, yet the results still left a great deal to be desired. As a next resource I made the final adjustment whilst keeping the galvanometer in circuit and unshunted. As was to be expected I soon discovered that to do so was almost an impossibility, owing to the strong extra currents prevailing in the bridge at the moment the battery was put in circuit, which threw the spot from left to right as the case might be, and made in consequence any reading impossible.

Thinking this phenomena might be due to magnetic effect, I wound several coils of different sized wires and stranded some before winding, but uselessly ; they all gave more or less the same result. Strange to say, if I substituted either a German silver or a platinum-silver coil no such disturbance took place. Since then I have always regarded copper as by far a greater favourite for extra currents than German silver or platinum-silver. I thought at times that this disturbance might be neutralised by means of an automatic commutator intersecting the diagonals, but never carried the idea into practice.

It was for the learned professor to be illuminated with the beautiful idea of intersecting the same by means of his sonometer ; he has by this means given to the world a very useful instrument, for which "Time" will not fail to redound it to his credit.

Whether the self-induction is measured directly by the V of the inner coil is a matter of no great moment, as it will not be long before mathematicians find out what is the correct function on which it depends.

As for (3) this was already known, except in so far as the electromotive force of the extra currents was thought to vary inversely with the section. As for the maximum inductive point as mentioned in (5) it is at least, to my limited faculty of perception, a great "puzzle." In regard to the increase of resistance (8) in the variable period it is very difficult to form a definite opinion, since as in the case of non-magnetic metals and alloys it remains still a doubt (until further researches are made) whether it is due to a purely molecular resistance, or whether it is, instead (as most

probably), due to an opposite electromotive force of the previous extra current, of which the primary current has to encounter and clear itself at every alternation.

It would be idle to imagine (14) a material gain by subdividing telegraph and telephone wires simply for the sole purpose of diminishing self-induction, considering, as would be the case (apart from creating an inconvenience by the multiplicity of wires on poles) the great drawback in consequence of a probable increase of mutual induction between one line with the other. As for the possibility of adapting the same subdivisions in wires on coils for any particular purpose, the advantage which would be derived would hardly (in my humble opinion) compensate for the loss in effect of the current upon a given point, in consequence of a decidedly increased bulk in the bobbin, in which the mean centre of the currents would be more separated from the centre of the coil.

Ultimately for bi-metallic conductors (17) should they prove to be correct, it will be a great gain in rapid telegraphy and telephony, and perhaps it will tend to clear up some of the mysteries enveloping the extraordinary results obtained in long distance telephoning, with compound wires, as was the case only a few years back with the 1,000 miles telephoning between New York and Chicago.

A. E. Conti.

Charlton, *April 20th*, 1886.

Two Polar v. Multipolar Dynamos.

I should feel obliged if those of your readers who have had practical experience with dynamo machines would mention the advantages and disadvantages which they have found with the above two forms of machines, and give their opinion as to which form is the most efficient commercially. There seems to be a great diversity of opinion on this subject; some say that the fewer poles there are in a machine the better, others that many poles give the best results.

In support of the latter, I would mention the case of the Victoria dynamo. In the discussion following Professor Sylvanus Thompson's paper on "Recent Progress in Dynamo-Electric Machines," read before the Society of Arts, February 28th, 1884, Mr. Percy Sellon said that, taking an original Schuckert machine, capable of giving 60 incandescent lamps of a certain power, by substituting four poles for two, the mass of which, both in iron and in copper, was very little in excess of that in the original two, and using identically the same ring, they obtained 100 lights, and a much better result in the commutator. He also said that, in constructing large dynamos, they were increasing the number of poles to six and eight, and, eventually probably, they would go to twelve for very large machines. Then again, the Gülcher dynamos have four and six poles; and the larger Elwell-Parker machines have four poles.

But, on the other hand, there are the two polar machines of Gramme, Elwell-Parker, Kapp, Crompton, Joel, the Phœnix, and many others; so that, if anything is to be adduced from numbers, makers are decidedly in favour of two pole machines. In most of these the armatures take the form of the elongated or cylindrical Gramme ring. I do not know whether this is the reason of their having only two poles.

There is also one other subject about which I should be glad to receive some information.

The following is quoted from Professor Thompson's paper already referred to:—"It is a singular result that, while in those machines in which the ring armature is extended cylinderwise, there must be wide embracing pole pieces; in those in which the ring is flattened into a disc shape the pole pieces must on no account be wide." Now, does this refer to two polar dynamos with flattened ring armatures, or only to multipolar machines of this type? I have heard it said that it only refers to the latter; is this so, and why?

I trust you will excuse my occupying so much of your valuable space, but I believe this subject will be of interest to many.

W. E. Hayne.

April 20th, 1886.

Dynamo Tests.

In your last issue you call attention to certain discrepancies between the indicated and electrical horse-powers as shown in Table VI., and call for some explanation of them.

You will notice that the report states that there was great difficulty in keeping the speed uniform when running without governors and with boilers too small for the work.

No doubt these sudden fluctuations are the cause of the apparent discrepancies, as although great care was taken to get simultaneous readings, in some cases the indicator cards were taken a few seconds later than the electrical readings.

But the main fact remains that a certain quantity of water was accurately weighed into the boilers, and from this quantity a net electrical output was obtained at the rate of 1 electrical horse-power hour for each 31·5 lbs. of water evaporated.

We cannot see how any discrepancies such as those you have called attention to can in any way affect the accuracy of the economical results obtained as above.

Those who conducted the trials have satisfied themselves that the figures are published exactly as obtained —without any alteration or rounding off whatever.

We believe that by publishing these results exactly as obtained we are serving the best interests of students and others interested in these matters.

R. E. Crompton & Co.

Chelmsford, *April 20th*, 1886.

Telephoning between Ship and Shore.

As I see several communications in your valuable paper with regard to connecting up ships by telephone, the following may prove of interest.

In 1883-1885, when I was in charge at Mauritius for the Oriental Telephone Company, I used regularly twice a month to connect up the Messageries Maritimes mail steamers with the Exchange at Port Louis.

The wire was run to the side of the harbour and there connected to a cable 300 yards long; the end of the cable was attached to a buoy, and a lead taken from it into the steamer.

This worked fairly well for a time, but the cable was always getting into trouble through ships' anchors, &c., so I employed a light cable, which was run out on the arrival of the mail and taken up on her departure.

This answered very well, and was working when I left.

Besides the mails I also connected a line of steamers from Bombay, and sometimes have had two ships at once connected by switches on to the line, with as much as 600 yards of cable out.

Harold Dowson.

30, Rendezvous Street, Folkestone,
April 23rd, 1886.

Economy in Electrical Conductors.

Would one of your many correspondents explain how Profs. Ayrton and Perry obtain the expression (the 2nd term),

$$c^2 r + \frac{t}{r},$$

which is used in their paper, published in your number for March 19th, under "Proceedings of Societies."

E. O. W.

April 21st, 1886.